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ASYMMETRIC EXCHANGE RATE AND OIL PRICE PASS-THROUGH TO ALGERIAN CONSUMER PRICES

Siham Boudab
Université Larbi Ben M'hidi Oum El Bouaghi, Oum El Bouaghi, Algeria
https://orcid.org/0009-0009-5735-1315

Nesrine Arous
University of Constantine 2 Abdelhamid Mehri, Constantine, Algeria
https://orcid.org/0009-0009-9161-0608

Sami Bendjeddou
Abdelhafid Boussouf University of Mila, Mila, Algeria
https://orcid.org/0009-0001-1438-3650

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A B S T R A C T

Algerian consumer prices are exposed to exchange-rate movements and oil-price shocks through import costs, domestic liquidity, and the fiscal consequences of hydrocarbon revenues. This study tests whether these pass-through channels were asymmetric over 1987–2025. The analysis applies a nonlinear autoregressive distributed lag model to a raw annual database of 39 observations covering the consumer price index, official exchange rate, Brent crude oil price, broad money, and real gross domestic product. The estimates identify statistically significant long-run asymmetry in exchange-rate pass-through, with depreciations and appreciations producing different price responses. Oil-price increases and decreases are likewise asymmetric in the long run, whereas the short-run evidence is weaker and significant only at the 10% level. The error-correction coefficient implies that about 39.3% of the previous year's disequilibrium is removed within one year. Inflation management in Algeria should therefore distinguish between the direction of currency and oil-price movements rather than assume symmetric transmission. Coordinated exchange-rate, monetary, and fiscal responses may help contain persistent pressure on consumer prices.

Address of the corresponding author:
Nesrine Arous
nesrine.arous@univ-constantine2.dz

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1 INTRODUCTION

1.1 Exchange-Rate and Oil-Price Exposure in Algeria

Algerian consumer prices are exposed to two closely related external channels: movements in the dinar exchange rate and fluctuations in international oil prices. Exchange-rate transmission begins with the domestic-currency cost of imported final goods, intermediate inputs, and capital equipment, especially when importers and distributors cannot absorb currency losses through their margins. Oil-price transmission is less direct. Although Algeria exports hydrocarbons, energy prices still affect transport and production costs, public revenue, liquidity, and access to foreign exchange. The channels overlap without being interchangeable: oil-price movements can change fiscal and external conditions, whereas changes in the dinar immediately revalue imports in local currency (Goldberg & Campa, 2010; Laourari & Abderrahim, 2022).

The official exchange rate matters not only for the border price of imports, but also for the broader domestic pricing environment. The extent of pass-through depends on invoicing practices, market structure, the inflation environment, and policy credibility. Firms may raise prices promptly after a depreciation to protect replacement costs, yet transmit an appreciation more slowly when downward price rigidity or margin rebuilding is present. In a managed exchange-rate regime, the timing and size of official adjustments can also influence expectations. Evidence on Algeria's de facto regime confirms that exchange-rate management remains central to the macroeconomic setting, making symmetry an empirical question rather than a defensible assumption (Choudhri & Hakura, 2006; Chekouri et al., 2022).

Oil-price movements introduce a second source of potential asymmetry. An increase can strengthen export receipts and fiscal space while simultaneously transmitting international cost pressures. A decline can erode public revenue, reduce foreign-exchange buffers, and intensify pressure on the exchange rate. Algeria's status as an oil exporter therefore does not determine the net effect on consumer prices; the outcome depends on domestic transmission. Existing Algerian studies link oil-price movements to both inflation and the exchange rate, but the strength and direction of these relationships vary across horizons and methods (Lacheheb & Sirag, 2019; Chekouri et al., 2021; Mehibel et al., 2024).

1.2 Research Problem and Literature Gap

Existing Algerian research provides a substantial basis for this analysis. Lacheheb and Sirag (2019) applied a nonlinear autoregressive distributed lag model to oil prices and inflation. Mizi Allaoua and Achouche (2017) examined exchange-rate pass-through within Algeria's fear-of-floating setting, while Mahloul and Bendahmane (2022) traced the transmission of exchange-rate changes to domestic prices. More recent studies move closer to the joint question: Hannachi (2023) analysed asymmetric oil-price and exchange-rate effects on inflation in a nonlinear framework, and Zeraka and Benbouziane (2025) focused on exchange-rate pass-through to consumer prices. This evidence establishes the relevance of nonlinear transmission in Algeria and creates a clear basis for an updated, directly comparable assessment of both channels.

A remaining issue is comparability across studies. Differences in samples, price measures, and empirical designs make it difficult to assess exchange-rate and oil-price transmission on a common basis. This study therefore estimates their joint asymmetric pass-through to consumer prices over 1987–2025 within one consistent framework. The sample covers major currency adjustments, reversals in the oil market, the pandemic disturbance, and the inflation episode that followed. Using the same data structure and controls for both channels allows their direction and persistence to be compared directly.

1.3 Research Objective and Questions

The analysis determines whether positive and negative exchange-rate and oil-price movements have different short- and long-run effects on Algerian consumer prices. It addresses four questions: whether the long-run response to dinar depreciation differs from the response to appreciation; whether oil-price increases and decreases have different long-run effects; whether short-run oil-price pass-through is asymmetric; and how quickly deviations from the long-run relationship are corrected after a disturbance. These are questions about conditional dynamic associations, not claims of structural causality.

1.4 Contribution of the Study

The study contributes in four related ways. It updates the Algerian evidence through 2025 and places exchange-rate and oil-price asymmetries within the same empirical setting. By distinguishing immediate responses from persistent effects, it avoids reducing pass-through to a single average coefficient. The design also provides a basis for assessing whether shocks in opposite directions merit different attention in exchange-rate management, liquidity control, and fiscal buffering. That distinction matters because a linear average can conceal economically different adjustment paths.

1.5 Structure of the Paper

The paper proceeds as follows. Section 2 develops the theoretical framework and reviews the relevant evidence. Section 3 presents the data and preliminary analysis, and Section 4 sets out the econometric methodology. Section 5 reports the empirical results. Section 6 discusses their interpretation and policy implications, while Section 7 concludes.

2 THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Exchange-Rate Pass-Through to Consumer Prices

Exchange-rate pass-through describes the change in domestic prices associated with a movement in the nominal exchange rate. In the simplest case, depreciation raises import prices in domestic currency and eventually reaches consumer prices. Complete pass-through would require foreign-currency prices and domestic margins to remain unchanged. Exporters may instead adjust markups, importers may hedge or absorb part of the shock, and local distribution costs may dilute the border-price change. Pass-through to consumer prices is consequently often smaller and slower than pass-through to import prices (Dornbusch, 1987; Menon, 1995; Goldberg & Knetter, 1997).

Its magnitude depends on several mechanisms. Persistent depreciation is more likely than a temporary movement to enter replacement costs. Firms may alter markups to defend market share, and the invoicing currency determines which party bears the initial exchange-rate risk. The inflation environment also shapes adjustment: high inflation encourages more frequent price revision, whereas credible policy can limit expected persistence and second-round effects (Taylor, 2000; Campa & Goldberg, 2005; Choudhri & Hakura, 2006).

Domestic distribution margins further weaken the direct link between the exchange rate and the consumer price index. Imported inputs pass through local production before reaching consumers, while transport, retail, and tax components are not revalued mechanically. The final response therefore depends on trade exposure and imported content. It also varies with the shock behind the currency movement; a domestic-demand disturbance need not produce the same inflation response as an external financial shock (Gopinath & Itskhoki, 2010; Goldberg & Campa, 2010; Ha et al., 2020).

2.2 Oil-Price Pass-Through to Inflation

Oil prices reach inflation through direct and indirect cost channels. Direct transmission occurs through fuel and other energy items, while indirect effects operate through freight, electricity, petrochemical inputs, and distribution costs. The resulting consumer-price response depends on energy intensity, administered prices, taxes, subsidies, and firms' margins. Even a large international oil-price movement may therefore produce a much smaller change in headline inflation (Hooker, 2002; Chen, 2009; Choi et al., 2018).

The economic source of the oil-price movement also matters. Supply disruptions, global demand shifts, and oil-market-specific demand can generate similar changes in crude prices but very different macroeconomic effects. Treating all such movements as a single exogenous impulse can obscure the inflation mechanism (Hamilton, 2003; Kilian, 2008, 2009). Pass-through estimates should therefore not assume that every observed increase or decrease in oil prices represents the same type of shock.

For an oil exporter, fiscal and external transmission may reinforce or offset the cost channel. Higher prices can raise government revenue, public expenditure, bank liquidity, and foreign-exchange availability; lower prices can reverse these effects and place pressure on the exchange rate and fiscal position. The net response of consumer prices is therefore an empirical matter. Cross-country evidence attributes differences in pass-through to monetary arrangements, institutional conditions, and the role of the commodity sector in the domestic economy (Gelos & Ustyugova, 2017; López-Villavicencio & Pourroy, 2019).

2.3 Why Pass-Through May Be Asymmetric

Asymmetry can emerge even when the basic cost mechanism is unchanged. Firms may raise prices quickly after depreciation or an oil-price increase because replacement costs are immediately visible, yet reverse those increases more slowly when costs fall. Menu costs, imperfect competition, inventory valuation, and uncertainty about the persistence of favourable movements can all sustain this pattern. Exchange-rate intervention and administered energy prices may add a policy dimension by smoothing one direction of adjustment more than the other (Delatte & López-Villavicencio, 2012; Bussière, 2013).

Pass-through may also depend on the state of the economy. Large depreciations can cross thresholds that smaller movements do not, while high inflation shortens the interval between price revisions and low inflation makes firms more willing to absorb temporary shocks. Oil-price increases and decreases may also trigger different fiscal, subsidy, and exchange-rate responses. Evidence for emerging markets and the BRICS countries accordingly finds that pass-through varies across directions, regimes, and thresholds rather than remaining centred on one stable mean coefficient (Caselli & Roitman, 2019; Balcilar et al., 2021; Li & Guo, 2022).

In a nonlinear pass-through model, positive and negative partial sums capture cumulative movements in opposite directions; they should not be treated as independent economic variables. Asymmetry means that the response to one direction cannot be inferred mechanically from the response to the other. It does not identify the institutional source of the difference. Interpretation must therefore combine the sign of the underlying movement with the exchange-rate, fiscal, and pricing environment.

2.4 International Empirical Evidence

International evidence generally reports incomplete pass-through, but its stability across countries and periods remains disputed. Early studies emphasized inflation and pricing behaviour. Subsequent work found that the estimated coefficient varies with the monetary regime, institutional quality, trade exposure, and the shock that drives the exchange rate (López-Villavicencio & Mignon, 2017; Forbes et al., 2018; Ha et al., 2020). A single linear estimate may therefore average across episodes with different economic content.

Nonlinear studies document a comparable degree of heterogeneity. Delatte and López-Villavicencio (2012) and Bussière (2013) report that exchange-rate pass-through can vary with the direction and size of the movement, while Caselli and Roitman (2019) identify nonlinearities in emerging markets. Oil-price effects likewise differ across upward and downward shocks and depend on the inflation regime and policy setting (López-Villavicencio & Pourroy, 2019; Garzón & Hierro, 2021). Research that includes oil prices and exchange rates in the same model also finds both channels relevant, even when their effects are estimated conditionally rather than through an explicit interaction term (Husaini & Lean, 2021; Ding et al., 2023).

2.5 Evidence from Algeria and the MENA Region

The Algerian literature can be organized into three strands. The first concerns exchange-rate pass-through. Mizi Allaoua and Achouche (2017) analyse it within a managed-exchange-rate setting, Mahloul and Bendahmane (2022) trace its transmission to domestic inflation, and Zeraka and Benbouziane (2025) provide a recent nonlinear assessment of consumer prices. These studies confirm that the official exchange rate is relevant to domestic prices, but they do not eliminate the need to compare its positive and negative movements jointly with oil-price shocks over an updated sample.

A second strand examines oil prices and inflation. Lacheheb and Sirag (2019) identify nonlinear oil-price effects, Mehibel et al. (2024) assess the relative importance of transmission channels in a structural framework, and Chellai (2025) extends the analysis to international food and oil prices. Their results imply that the Algerian oil-inflation relationship cannot be reduced to direct energy costs; fiscal, external, and food-price channels may also matter.

The third strand addresses the oil-exchange-rate nexus. Chekouri et al. (2021) document nonlinear and frequency-dependent relationships, while Ayad et al. (2023) find that predictive links vary over time and frequency. Hannachi (2023) provides the closest direct comparison, using annual data for 1973–2021 with oil prices, the exchange rate, money supply as a share of GDP, and an output gap measured as the deviation of logged real GDP from its Hodrick–Prescott-filtered trend. The current analysis updates the evidence through 2025 and uses logged broad money and logged real GDP as controls. The distinction lies in temporal coverage and model specification, not in a longer sample.

Regional studies offer a secondary benchmark. Threshold evidence for Tunisia finds that exchange-rate effects vary across movements, while Moroccan results support a material exchange-rate-inflation relationship (Chroufa & Chtourou, 2023; Erraitab et al., 2024). At the MENA level, connectedness among oil prices, exchange rates, and inflation places domestic price dynamics within common regional and global disturbances (Bigerna, 2024). Algeria's hydrocarbon dependence and managed exchange rate nevertheless warrant country-specific estimation.

2.6 Research Hypotheses

These theoretical mechanisms and empirical findings yield three testable hypotheses. H1 states that positive and negative exchange-rate movements have significantly different long-run effects on Algerian consumer prices. H2 states that positive and negative oil-price movements have significantly different long-run effects. H3 states that the cumulative short-run effects of positive and negative oil-price movements are significantly different.

3 DATA AND PRELIMINARY ANALYSIS

3.1 Variable Description and Data Sources

The raw database comprises 39 annual observations for Algeria over 1987–2025. Constructing the positive and negative partial sums requires first differences, so these series begin in 1988. The selected error-correction specification also includes a one-period lag of the level terms. As a result, 1989 is the first common estimation date, and the final EViews sample covers 1989–2025 with 37 observations.

LCPI denotes the natural logarithm of the consumer price index and represents the domestic price level. LEXR is the logarithm of the official exchange rate, measured in Algerian dinars per US dollar; an increase therefore denotes depreciation. LOIL is the logarithm of the annual international crude-oil price. LM2 captures monetary liquidity, and LRGDP represents real economic activity. In the nonlinear model, the exchange rate and oil price are decomposed into cumulative positive and negative changes, whereas LM2 and LRGDP enter as linear controls.

Consumer prices, the official exchange rate, broad money, and real GDP come from the World Bank World Development Indicators. The Brent oil-price series is obtained from Federal Reserve Economic Data under code ACOILBRENTEU. Table 1 reports the definitions, transformations, model roles, and source codes used in the analysis.

Table 1. *Variable and Data Source*

Variable	Description	Transformation	Role in the model	Source and Series code
LCPI	Consumer price index (2010 = 100), used as a proxy for the domestic price level.	Natural logarithm	Dependent variable	World Bank, World Development Indicators. **Code**: FP.CPI.TOTL
LEXR	Official exchange rate, Algerian dinars per US dollar, period average. An increase denotes a depreciation of the dinar.	Natural logarithm; decomposed into positive and negative partial sums in the NARDL model	Main asymmetric explanatory variable	World Bank, World Development Indicators. **Code**: PA.NUS.FCRF
LOIL	International crude oil price in US dollars per barrel, annual average.	Natural logarithm; decomposed into positive and negative partial sums in the NARDL model	Main asymmetric explanatory variable	Federal Reserve Economic Data, Federal Reserve Bank of St. Louis. **Code**: ACOILBRENTEU
LM2	Broad money in current Algerian dinars, representing monetary liquidity.	Natural logarithm	Linear control variable	World Bank, World Development Indicators; underlying source: IMF International Financial Statistics. **Code**: FM.LBL.BMNY.CN
LRGDP	Gross domestic products at constant local currency prices, representing real economic activity.	Natural logarithm	Linear control variable	World Bank, World Development Indicators; national accounts data. **Code**: NY.GDP.MKTP.KN

3.2 Descriptive Statistics

Table 2 reports the distributional properties of the logged series across the full 39-observation database. LCPI and LEXR are left-skewed and depart most clearly from normality, whereas LOIL is nearly symmetric. LM2 records the largest standard deviation, consistent with the pronounced long-run expansion and variation of nominal liquidity, while LRGDP varies comparatively little. These descriptive features motivate a dynamic specification but do not establish either the order of integration or the direction of pass-through.

Table 2. *Descriptive Statistics*

	LCPI	LEXR	LOIL	LM2	LRGDP
Mean	4.3055	4.0535	3.7004	28.9268	25.6482
Median	4.4274	4.2942	3.7759	29.2141	25.6923
Maximum	5.3447	4.9557	4.7151	30.9092	26.1683
Minimum	2.4416	1.5789	2.5463	26.2758	25.1885
Std. Dev.	0.8035	0.8846	0.7009	1.5102	0.3308
Skewness	-0.9871	-1.5227	-0.0684	-0.3442	-0.0420
Kurtosis	3.1205	4.4353	1.4975	1.7055	1.4928
Jarque-Bera	6.3579	18.4200	3.6987	3.4934	3.7028
Probability	0.0416	0.0001	0.1573	0.1743	0.1570
Observations	39	39	39	39	39

3.3 Stationarity Analysis and Integration Orders

Stationarity is evaluated with the augmented Dickey–Fuller and Phillips–Perron tests under the three deterministic specifications reported in Table 3. The results classify LCPI and LEXR as I(0). LOIL, LM2, and LRGDP are non-stationary in levels but stationary after first differencing and are therefore I(1). None of the series is integrated of order two, so the combination of I(0) and I(1) variables is admissible within the ARDL bounds-testing framework.

Table 3. *ADF and PP Unit Root Test Results*

UNIT ROOT TEST RESULTS TABLE (ADF)				UNIT ROOT TEST RESULTS TABLE (PP)			
Null hypothesis: the variable has a unit root				Null hypothesis: the variable has a unit root			
At Level				**At Level**			
Variable	With Constant	With Constant & Trend	Without Constant & Trend	With Constant	With Constant & Trend	Without Constant & Trend	**Decision**
LCPI	-4.5964***	-4.4199***	4.9806	-3.1378**	-2.1329	2.3280	I(0)
LEXR	-5.2236***	-3.1405	2.4837	-5.1632***	-3.1159	1.4088	I(0)
LOIL	-1.3218	-2.0390	0.5320	-1.2351	-2.0389	0.7154	-
LM2	-2.5848	0.3511	3.2190	-2.4522	0.4026	6.9534	-
LRGDP	0.5544	-1.9757	6.8623	0.2876	-2.2339	5.1266	-
At First Difference				**At First Difference**			
Variable	With Constant	With Constant & Trend	Without Constant & Trend	With Constant	With Constant & Trend	Without Constant & Trend	**Decision**
LOIL	-5.9933***	-5.9262***	-5.8619***	-5.8655***	-5.8599***	-5.6778***	I(1)
LM2	-4.2787***	-5.0596***	-2.1919**	-4.2787***	-4.9712***	-1.8939*	I(1)
LRGDP	-4.7120	-4.6479***	-1.4914	-4.8011***	-4.7489***	-2.4281**	I(1)

The unit-root results establish the integration structure required for nonlinear ARDL estimation; they do not establish cointegration. The bounds test in the empirical results section evaluates the existence of a level relationship separately.

4 ECONOMETRIC METHODOLOGY

Because the database comprises only 39 annual observations, the nonlinear specification is necessarily parsimonious. The construction of partial sums and the lagged level terms further reduces the estimation sample to 37 observations over 1989–2025. This horizon is sufficient to cover major exchange-rate adjustments, oil-market reversals, the pandemic disturbance, and the subsequent inflation episode, but it does not allow short-run asymmetries at higher frequencies to be identified. The reported results should therefore be read as annual conditional associations rather than as evidence on quarterly or monthly transmission mechanisms.

4.1 Proposed Model

The empirical strategy estimates the dynamic effects of exchange-rate movements and oil-price shocks on Algerian consumer prices using annual data for 1987–2025. Once the nonlinear partial sums are constructed and the one-period lag is applied, the final EViews sample covers 1989–2025 and contains 37 observations. $LCPI_t$ is the natural logarithm of the consumer price index. The regressors are $LEXR_t$, the logarithm of the official exchange rate in Algerian dinars per US dollar; $LOIL_t$, the logarithm of the international crude-oil price; $LRGDP_t$, the logarithm of real gross domestic product; and $LM2_t$, the logarithm of broad money. Consumer prices, the official exchange rate, real GDP, and broad money are drawn from the World Bank World Development Indicators. The oil-price series comes from Federal Reserve Economic Data, Federal Reserve Bank of St. Louis, series ACOILBRENTEU. An increase in $LEXR_t$ represents a depreciation of the Algerian dinar.

The proposed long-run relationship is:

$$LCPI_t = \alpha_0 + \alpha_1 LEXR_t^{+} + \alpha_2 LEXR_t^{-} + \alpha_3 LOIL_t^{+} + \alpha_4 LOIL_t^{-} + \alpha_5 LRGDP_t + \alpha_6 LM2_t + \varepsilon_t$$

Following Shin, Yu, and Greenwood-Nimmo (2014), the nonlinear ARDL specification decomposes the exchange rate and oil price into cumulative positive and negative changes. Real GDP and broad money remain linear because the analysis focuses on asymmetry in exchange-rate and oil-price shocks. The partial-sum decompositions are defined as:

$$LEXR_t^{+} = \Sigma_{j=1}{}^{t}\, max(\Delta LEXR_j, 0), \quad LEXR_t^{-} = \Sigma_{j=1}{}^{t}\, min(\Delta LEXR_j, 0)$$

$$LOIL_t^{+} = \Sigma_{j=1}{}^{t}\, max(\Delta LOIL_j, 0), \quad LOIL_t^{-} = \Sigma_{j=1}{}^{t}\, min(\Delta LOIL_j, 0)$$

$LEXR_t^+$ and $LEXR_t^-$ represent cumulative depreciations and appreciations of the dinar, respectively, while $LOIL_t^+$ and $LOIL_t^-$ represent cumulative oil-price increases and decreases. The decomposition makes it possible to test directly whether consumer prices respond equally to movements in opposite directions. Because negative partial sums are non-positive by construction, their coefficients must be read together with the sign of the underlying partial-sum change rather than interpreted as ordinary elasticities in isolation.

4.2 NARDL Framework: Long-Run and Short-Run Relationships

The nonlinear autoregressive distributed lag framework can be estimated by ordinary least squares after lag selection, accommodates variables integrated of order zero or one provided that none is integrated of order two, and places short-run dynamics and long-run asymmetric effects in a single conditional error-correction model. The ARDL framework follows Pesaran and Shin (1999), the bounds-testing procedure follows Pesaran, Shin, and Smith (2001), and the asymmetric extension follows Shin et al. (2014).

The conditional error-correction representation is specified as:

$$\begin{aligned}\Delta LCPI_t &= \mu + \rho LCPI_{t-1} + \theta_1 LEXR_{t-1}^+ + \theta_2 LEXR_{t-1}^- + \theta_3 LOIL_{t-1}^+ \\ &+ \theta_4 LOIL_{t-1}^- + \theta_5 LRGDP_{t-1} + \theta_6 LM2_{t-1} + \Sigma_{i=1}\text{^}(p-1)\, \phi_i \Delta LCPI_{t-i} \\ &+ \Sigma_{i=0}\text{^}(q_1-1)\, \delta_{1i}\Delta LEXR_{t-i}^+ + \Sigma_{i=0}\text{^}(q_2-1)\, \delta_{2i}\Delta LEXR_{t-i}^- \\ &+ \Sigma_{i=0}\text{^}(q_3-1)\, \delta_{3i}\Delta LOIL_{t-i}^+ + \Sigma_{i=0}\text{^}(q_4-1)\, \delta_{4i}\Delta LOIL_{t-i}^- \\ &+ \Sigma_{i=0}\text{^}(q_5-1)\, \beta_{1i}\Delta RGDP_{t-1} + \Sigma_{i=0}\text{^}(q_6-1)\, \beta_{2i}\Delta LM2_{t-i} + u_t\end{aligned}$$

The parameter ρ is expected to be negative when a stable long-run relationship exists. The normalized long-run coefficients are obtained from the lagged-level parameters as follows:

$$\begin{aligned}\lambda LEXR^+ &= -\theta_1/\rho,\quad \lambda LEXR^- = -\theta_2/\rho,\quad \lambda LOIL^+ = -\theta_3/\rho \\ \lambda LOIL^- &= -\theta_4/\rho,\quad \lambda LRGDP = -\theta_5/\rho,\quad \lambda LM2 = -\theta_6/\rho\end{aligned}$$

The corresponding restricted error-correction form is:

$$\begin{aligned}\Delta LCPI_t &= \eta ECT_{t-1} + \Sigma_{i=1}\text{^}(p-1)\, \phi_i \Delta LCPI_{t-1} \\ &+ \Sigma_{i=0}\text{^}(q_1-1)\, \delta_{1i}\Delta LEXR_{t-i}^+ + \Sigma_{i=0}\text{^}(q_2-1)\, \delta_{2i}\Delta LEXR_{t-i}^- \\ &+ \Sigma_{i=0}\text{^}(q_3-1)\, \delta_{3i}\Delta LOIL_{t-i}^+ + \Sigma_{i=0}\text{^}(q_4-1)\, \delta_{4i}\Delta LOIL_{t-i}^- \\ &+ \Sigma_{i=0}\text{^}(q_5-1)\, \gamma_{1i}\Delta LRGDP_{t-i} + \Sigma_{i=0}\text{^}(q_6-1)\, \gamma_{2i}\Delta LM2_{t-i} + u_t.\end{aligned}$$

where the error-correction term is:

$$\begin{aligned}ECT_{t-1} &= LCPI_{t-1} - \lambda_0 - \lambda LEXR^+ LEXR_{t-1}^+ - \lambda LEXR^- LEXR_{t-1}^- \\ &- \lambda LOIL^+ LOIL_{t-1}^+ - \lambda LOIL^- LOIL_{t-1}^- \\ &- \lambda LRGPLRGDP_{t-1} - \lambda LM2LM2_{t-1}.\end{aligned}$$

The coefficient η captures the speed at which consumer prices return to long-run equilibrium after a short-run disturbance. A negative and statistically significant estimate supports an error-correction mechanism. Given the limited annual sample, the optimal lag structure is selected with the Akaike information criterion.

The bounds test evaluates the joint significance of the lagged-level variables. The null hypothesis of no long-run relationship is:

$$H_0: \rho = \theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = \theta_6 = 0$$

against the alternative that at least one level coefficient is non-zero. Long-run asymmetry is evaluated using the following Wald restrictions:

$$H_0, LEXR^{LR}: \lambda LEXR^+ = \lambda LEXR^-$$

$$H_0, LOIL^{LR}: \lambda LOIL^+ = \lambda LOIL^-$$

Short-run asymmetry is assessed through equality of the cumulative short-run coefficients:

$$H_0, LEXR^{SR}: \Sigma_{i=0}\text{^}(q_1-1)\, \delta LEXR,_i^+ = \Sigma_{i=0}\text{^}(q_2-1)\, \delta LEXR,_i^-$$

$$H_0, LOIL^{SR}: \Sigma_{i=0}\text{^}(q_3-1)\, \delta LOIL,_i^+ = \Sigma_{i=0}\text{^}(q_4-1)\, \delta LOIL,_i^-$$

Rejecting a restriction implies that positive and negative shocks have statistically different effects. Model adequacy is assessed with the Breusch–Godfrey serial-correlation test, heteroskedasticity tests, the Jarque–Bera normality test, Ramsey's RESET test, and the CUSUM and CUSUMSQ stability tests.

4.3 Dynamic Multipliers

Dynamic multipliers trace how consumer prices adjust after positive and negative exchange-rate and oil-price movements. The paths reveal whether asymmetry emerges immediately or gradually, how long it persists, and how quickly each response converges to its long-run equilibrium.

For the exchange rate, the cumulative dynamic multipliers are defined as:

$$MLEXR,h^{+} = \Sigma_{j=0}^{h}\,[\partial LCPI_{t+j} / \partial LEXR_{t}^{+}],\quad MLEXR,h^{-} = \Sigma_{j=0}^{h}\,[\partial LCPI_{t+j} / \partial LEXR_{t}^{-}]$$
$$h = 0, 1, 2, \ldots$$

For oil prices, they are:

$$MLOIL,h^{+} = \Sigma_{j=0}^{h}\,[\partial LCPI_{t+j} / \partial LOIL_{t}^{+}],\quad MLOIL,h^{-} = \Sigma_{j=0}^{h}\,[\partial LCPI_{t+j} / \partial LOIL_{t}^{-}]$$
$$h = 0, 1, 2, \ldots$$

As the horizon increases, the multiplier paths converge to the corresponding long-run coefficients:

$$lim_{h} \to \infty\, MLEXR,h^{+} = \lambda LEXR^{+},\quad lim_{h} \to \infty\, MLEXR,h^{-} = \lambda LEXR^{-}$$
$$lim_{h} \to \infty\, MLOIL,h^{+} = \lambda LOIL^{+},\quad lim_{h} \to \infty\, MLOIL,h^{-} = \lambda LOIL^{-}$$

The time profile of asymmetry is measured by the differences:

$$MLEXR,h^{+} - MLEXR,h^{-}$$
$$MLOIL,h^{+} - MLOIL,h^{-}$$

A persistent distance between the positive and negative multiplier paths denotes different consumer-price responses to dinar depreciation and appreciation, or to oil-price increases and decreases. The plots complement the Wald tests by showing the magnitude, direction, persistence, and speed of convergence of each asymmetric pass-through process.

5 EMPIRICAL RESULTS

5.1 Lag Length Criteria and Model Selection

The lag assessment is kept parsimonious because the series are annual and the raw database contains only 39 observations. In Table 4, the likelihood-ratio, Akaike, and Schwarz criteria select one lag, whereas the final-prediction-error and Hannan–Quinn criteria select two. The maximum lag is set to one to preserve degrees of freedom in a model with two pairs of nonlinear regressors.

Table 4. *VAR Lag Order Selection*

Lag	LogL	LR	FPE	AIC	SC	HQ
0	48.06139241	0	5.88E-08	-2.460651	-2.238458	-2.38395
1	252.6938835	42.92416*	2.08E-12	-16.53935*	-12.18512*	-12.26516
2	311.0117299	79.97876	1.15e-13*	-14.62924	-11.39221	-14.92863*
3	340.7833376	32.32346	3.35E-13	-14.90191	-11.34682	-13.67469
4	394.4385427	339.1053	3.4E-13	-12.72536	-11.8733	-13.78553

*Note: * indicates the lag order selected by the criterion*

Under the one-lag cap, the Akaike information criterion compares 16 candidate specifications. EViews selects ARDL(1,0,1,0,1), as shown in Figure 1. LM2 and LRGDP enter the automatic lag search as linear regressors, while LEXR and LOIL enter as dual nonlinear regressors. Because the partial sums begin after first differencing and the level terms are lagged, the common estimation period is 1989–2025, with 37 observations.

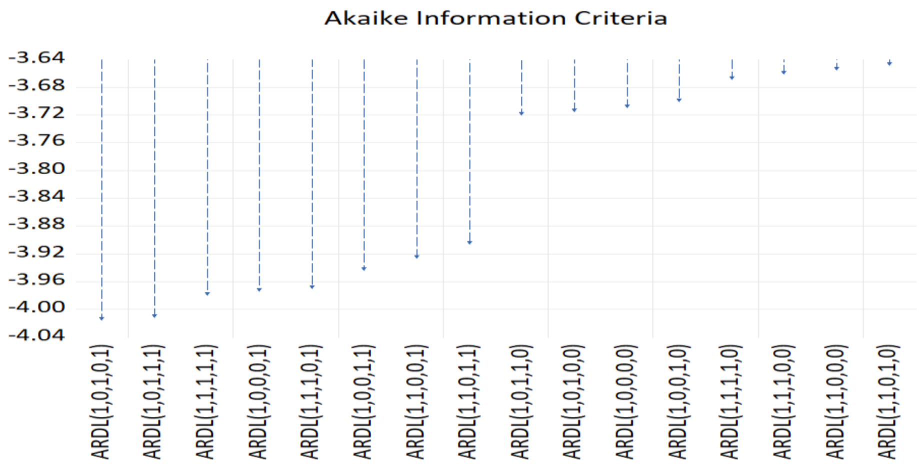

Figure 1. *The Choice of Best NARDL Model Based on AIC Criteria.*

5.2 Cointegration Analysis

For Case 2 and K = 6, Narayan's (2004) finite-sample critical values place the 1% upper bound at 5.121. The calculated F-statistic is 44.853 and therefore exceeds that threshold. The null hypothesis of no level relationship is rejected, allowing the long-run coefficients and error-correction mechanism of the selected NARDL specification to be interpreted.

Table 5. *Bounds test for cointegration*

Test Statistic	Value	K (Number of cointegrating variables)
F- Statistic	44.853	6
Bounds Critical Value		
Significance	**I(0)**	**I(1)**
10%	2.218	3.314
5%	2.618	3.863
1%	3.505	5.121

Note: Finite-sample critical values for Case 2 and K = 6 are based on Narayan (2004).

EViews reports that the p-values associated with the bounds test are incompatible with the t-bounds distribution. The finite-sample critical values provided by Narayan (2004) are therefore used as the benchmark rather than conventional asymptotic thresholds. For Case 2 and K = 6, the calculated F-statistic of 44.853 exceeds the 1% upper bound, supporting the existence of a long-run level relationship despite the limited annual sample.

5.3 NARDL Long Run and Short Run Estimates

The exchange-rate estimates differ sharply by direction. LEXR_pos equals 0.7802 and is statistically significant at the 1% level, associating cumulative depreciation with a higher consumer-price level, conditional on the other regressors. LEXR_neg equals -2.7755 and is also significant at the 1% level. Since appreciation is recorded as a negative movement in the negative partial sum, this coefficient must be interpreted jointly with that sign. The estimated branch is specific to the sample and does not establish a universal or causal appreciation effect.

Oil-price transmission is also direction dependent. LOIL_pos equals 0.0638 and is not statistically significant, whereas LOIL_neg equals -0.1874 with a probability of 0.0167. In a hydrocarbon-exporting economy, the latter long-run association is consistent with lower oil revenue weakening fiscal resources and foreign-exchange availability enough to offset direct cost relief. LM2 is not significant, while LRGDP is negative and significant at the 5% level. Both estimates remain conditional on the full model specification.

The error-correction coefficient is -0.3927 with a probability of 0.0000, so about 39.3% of the previous year's disequilibrium is removed within one year. D(LOIL_pos) equals -0.0858 and is significant at the 1% level. D(LOIL_neg) equals 0.0488 and is significant only at the 10% level; because the associated partial-sum change is negative, the implied short-run effect of an oil-price decline is negative. D(LRGDP) is not statistically significant.

Table 6. *NARDL Long Run and Short Run Form*

Selected model: ARDL(1,0,1,0,1)				
Long Run Estimates				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LM2	-0.0827	0.1389	-0.5959	0.5561
LRGDP	-1.4081**	0.5434	-2.5914	0.0146
LEXR_pos	0.7802***	0.0803	9.7183	0.0000
LEXR_neg	-2.7755***	0.6481	-4.2828	0.0002
LOIL_pos	0.0638	0.0892	0.7158	0.4797
LOIL_neg	-0.1874**	0.0739	-2.5349	0.0167
C	40.2815***	11.7574	3.4261	0.0018

Short Run Estimates				
COINTEQ	-0.3927***	0.0184	-21.3408	0.0000
D(LRGDP)	-0.1159	0.1693	-0.6847	0.4983
D(LOIL_pos)	-0.0858***	0.0289	-2.9636	0.0056
D(LOIL_neg)	0.0488*	0.0269	1.8146	0.0787
Diagnostics				
$R^2 = 0.8941$	$\overline{R^2} = 0.8845$	F-statistics = 92.884 (0.000)		DW = 1.8175

Note: ***, **, * denotes significant at 1, 5 and 10% respectively. Full results are available in Appendix A &B.

The long-run and short-run coefficients on broad money and real GDP are interpreted with caution. Given the annual frequency, the persistence of monetary aggregates and real activity, and the small sample, these parameters capture conditional associations within the specified NARDL framework rather than general monetary or growth–inflation relationships for Algeria. Their role is to control for liquidity and output conditions when assessing asymmetric exchange-rate and oil-price pass-through, not to provide a separate structural account of monetary or real dynamics.

5.4 Asymmetric Effects

The Wald tests provide different levels of support for the three asymmetry hypotheses. Long-run equality is rejected for the exchange rate (F = 37.030, p = 0.0000) and for oil prices (F = 15.164, p = 0.0006). For oil prices in the short run, the restriction is rejected at the 10% level (F = 3.962, p = 0.0571) but not at the 5% level. This evidence is weaker than the two long-run results.

Table 7. *Summary of Wald Test Results for Asymmetric Effects (NARDL)*

Variable	Horizon	Null Hypothesis	F- statistic	Probability	Result / Decision
LEXR	Long Run	C(4) = C(5)	37.030	0.0000***	Reject H_0 (Asymmetry exists)
LOIL	Long Run	C(6) = C(7)	15.164	0.0006***	Reject H_0 (Asymmetry exists)
LOIL	Short Run	C(10) = C(11)	3.962	0.0571*	Reject H_0 (Asymmetry exists)

Note: Full results are available in Appendix C.

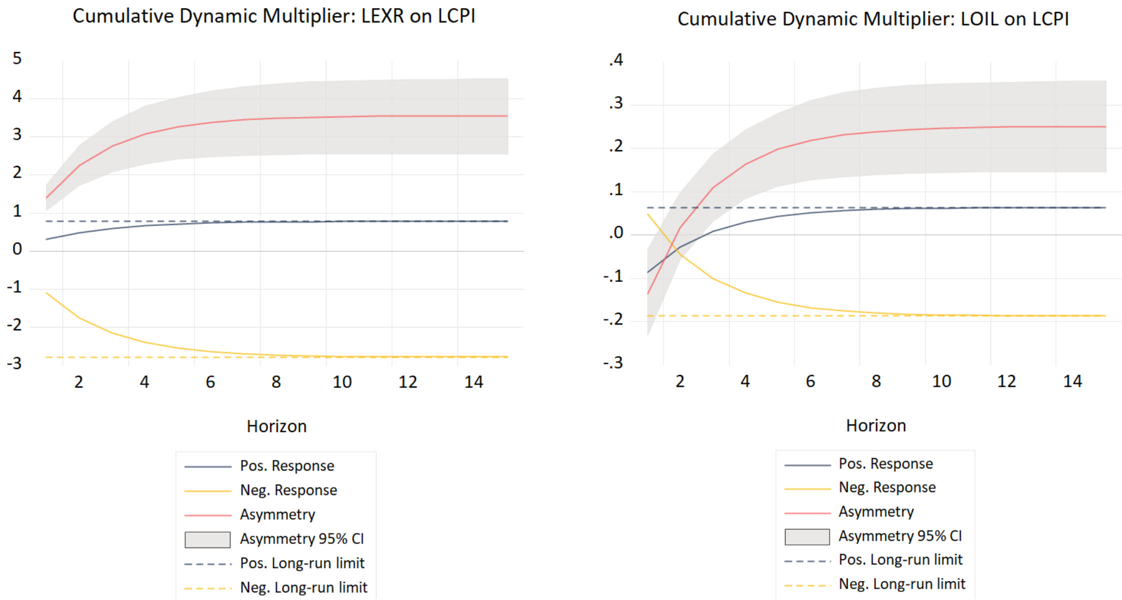

Figure 2*. Asymmetric Dynamic Multiplier Effects of LEXR and LOIL Shocks on LCPI.*

5.5 Dynamic Multiplier Analysis

Figure 2 traces the dynamic multiplier paths for exchange-rate and oil-price movements. The positive and negative exchange-rate responses diverge early and remain widely separated as the horizon lengthens, consistent with persistent long-run asymmetry. For oil prices, the gap develops over the first several horizons before approaching its long-run configuration. The plots support the Wald evidence and show that the two external channels converge at different speeds.

5.6 Diagnostic tests

None of the reported residual diagnostics identifies the corresponding form of misspecification. The Breusch–Godfrey statistic is 1.6571 with p = 0.4367; the Breusch–Pagan–Godfrey statistic is 0.4713 with p = 0.7619; the Jarque–Bera statistic is 1.1633 with p = 0.5589; and the RESET statistic is 0.0126 with p = 0.9113. The relevant null hypotheses are not rejected at conventional significance levels. These results support residual and functional-form adequacy, although they do not replace economic interpretation of the coefficients.

Table 8. *Diagnostic Test Results*

Test	Null Hypothesis (H_0)	Statistics [p-value]	Decision
Breusch–Godfrey Serial Correlation LM Test	No serial correlation in the residuals	1.6571 [0.4367]	Fail to reject $\mathrm{H}_0\boldsymbol{H_0}$
Breusch–Pagan–Godfrey Heteroskedasticity Test	Homoskedastic residuals	0.4713 [0.7619]	Fail to reject $\mathrm{H}_0\boldsymbol{H_0}$
Jarque–Bera Normality Test	Residuals are normally distributed	1.1633 [0.5589]	Fail to reject $\mathrm{H}_0\boldsymbol{H_0}$
Ramsey RESET Test	No functional-form misspecification	0.0126 [0.9113]	Fail to reject $\mathrm{H}_0\boldsymbol{H_0}$

5.7 Stability Analysis

Both the CUSUM and CUSUM of squares paths remain inside the 5% critical boundaries in Figure 3. The recursive-residual diagnostics are therefore consistent with coefficient stability over the estimation period. This evidence pertains only to the reported stability tests and does not exclude every possible structural change in the Algerian economy.

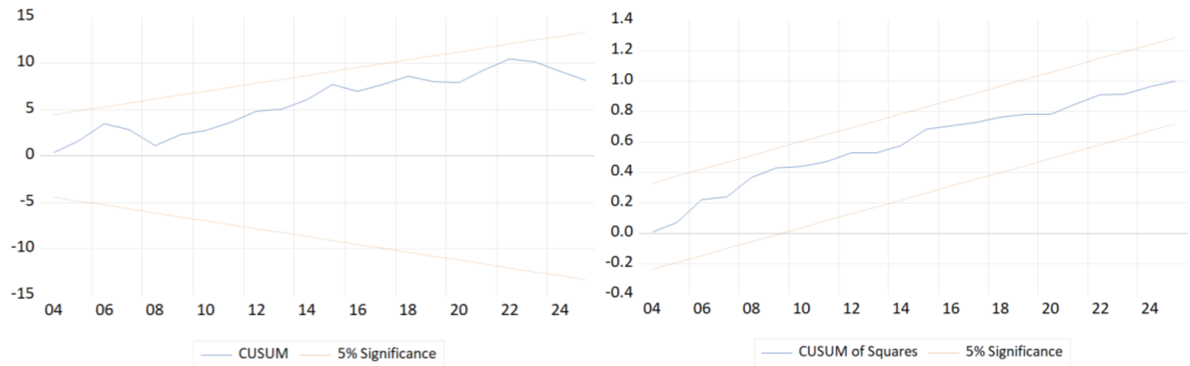

Figure 3. *Plot of CUSUM & CUSUM of Squares for Coefficient Stability of NARDL Model at 5% Level of Significance*

6 DISCUSSION AND POLICY IMPLICATIONS

6.1 Interpretation of Exchange-Rate Asymmetry

The exchange-rate estimates accord with an import-cost mechanism operating under a managed exchange-rate regime. Depreciation raises the dinar cost of imported consumer goods, intermediate inputs, and replacement inventories. When firms are uncertain about future official adjustments or access to foreign currency, they may price expected replacement costs before the full increase materializes. This reading is consistent with the importance of exchange-rate management in Algeria and with broader evidence that pass-through depends on the inflation environment and on the shock driving the currency movement (Choudhri & Hakura, 2006; Chekouri et al., 2022; Ha et al., 2020).

In Algeria, administered prices, subsidy arrangements, and the coexistence of official and parallel exchange rates add institutional content to the estimated asymmetry. Downward rigidity in regulated tariffs and the gradual adjustment of subsidy schemes can attenuate the transmission of appreciation episodes to retail prices even when the official exchange rate improves. Depreciation episodes, by contrast, tend to be reflected more quickly in import costs and replacement pricing, reinforcing the conditional association between dinar weakness and higher consumer prices.

The appreciation branch requires more careful interpretation. Its negative coefficient applies to a non-positive cumulative series, so appreciation episodes are conditionally associated with a higher price level in this sample. The result does not imply that appreciation is inherently inflationary. Rather, once the other regressors are held constant, improvements in the official rate did not produce proportional relief in consumer prices. Downward price rigidity, the rebuilding of margins, contracts set at earlier exchange rates, and incomplete transmission from the official rate to effective import costs are plausible explanations. This interpretation accords with nonlinear evidence and with Algerian studies that treat exchange-rate pass-through as regime dependent rather than mechanically symmetric (Mizi Allaoua & Achouche, 2017; Mahloul & Bendahmane, 2022; Zeraka & Benbouziane, 2025).

6.2 Interpretation of Oil-Price Asymmetry

The oil estimates reflect Algeria's position as both a hydrocarbon exporter and an economy exposed to international production and transport costs. The insignificant positive long-run coefficient means that, after controlling for the exchange rate, liquidity, and real activity, higher oil prices do not yield a stable long-run CPI elasticity. Additional hydrocarbon receipts may expand fiscal space and foreign-exchange availability, partly offsetting direct cost pressure. The negative short-run coefficient on positive oil movements is compatible with such an offset, although the model does not identify the channel structurally.

The hydrocarbon sector's role in fiscal revenue and foreign-exchange supply further shapes the asymmetric response to oil-price movements. When prices rise, the resulting fiscal and external buffers can coexist with higher energy and transport costs, producing a complex net effect on inflation. When prices fall, the direct cost relief is offset by tighter budgetary conditions, reduced bank liquidity, and potential exchange-rate pressures. The long-run association following oil-price declines thus reflects revenue, liquidity, and exchange-rate channels rather than a simple mirror image of price booms.

Oil-price declines follow a different temporal pattern. Their implied short-run effect is a modest reduction in consumer prices, consistent with direct cost relief. Over the long run, however, the negative partial-sum coefficient implies a higher price level after a decline. In an import-dependent economy, lower export receipts can weaken fiscal revenue, reduce foreign-exchange buffers, and increase exchange-rate pressure. This interpretation is consistent with Algerian evidence that oil affects inflation through several channels rather than through energy costs alone (Lacheheb & Sirag, 2019; Chekouri et al., 2021; Mehibel et al., 2024).

The short-run Wald result is borderline. Its probability of 0.0571 supports different oil responses at the 10% level, but not at the 5% level, and should therefore carry less weight than the two long-run rejections. Such caution is consistent with cross-country evidence that oil-price effects vary with the policy regime, the inflation state, and the source of the underlying oil-market movement (López-Villavicencio & Pourroy, 2019; Garzón & Hierro, 2021).

Hannachi's (2023) detailed Wald results offer a useful comparison. That study reports short-run exchange-rate asymmetry and long-run exchange-rate symmetry, whereas the current estimates reject symmetry in the long run. No separate short-run exchange-rate symmetry test is reported here because the selected specification contains no paired short-run exchange-rate terms. Both studies support long-run oil-price asymmetry. Hannachi finds short-run oil-price symmetry, while the evidence here points only to weak short-run asymmetry at the 10% level. The main differences therefore lie in the horizon at which exchange-rate asymmetry emerges and in the strength of the short-run oil result.

A comparable illustration can be drawn for oil prices. A sustained increase in international crude prices of the order of 20% strengthens export receipts and fiscal space but also raises production and transport costs. The estimated long-run coefficient suggests that the net consumer-price effect is positive and persistent once fiscal, liquidity, and exchange-rate channels are taken into account. By contrast, a similar cumulative decline in oil prices provides direct energy-cost relief yet may coincide with pressure on public revenue and foreign exchange. The long-run association following oil-price decreases is therefore weaker and operates through macroeconomic conditions rather than a one-to-one reversal of previous price increases.

6.3 Joint Interpretation for the Algerian Economy

Estimating oil prices and the exchange rate in the same equation is useful because their transmission channels overlap without coinciding. Oil revenue affects the fiscal position and the supply of foreign currency, whereas the exchange rate determines the dinar cost of imports. A decline in oil prices can weaken the external buffer that helps stabilize import costs, and depreciation can transmit that pressure directly to consumer prices. These are conditional associations; the model does not treat either variable as structurally exogenous.

The control variables also call for restraint. The insignificant LM2 coefficient does not imply that liquidity is irrelevant to Algerian inflation. Broad money is highly persistent, and some of its effect may operate through fiscal expenditure, credit conditions, or exchange-rate pressure already captured elsewhere in the equation. Likewise, the negative LRGDP coefficient is conditional on the included external and monetary variables and should not be read as a general growth–inflation relationship.

To illustrate the economic content of the estimated asymmetry, consider a cumulative depreciation episode of around 10%. The normalized long-run coefficient implies that such a movement is conditionally associated with a substantial increase in the consumer-price level, reflecting the contribution of imported replacement costs and the broader macroeconomic environment. An appreciation of similar magnitude would, given the negative sign of the partial sum, generate a much smaller relief in headline inflation. The example is not a structural forecast; it simply translates the asymmetric long-run coefficients into a stylized comparison of depreciation and appreciation episodes.

6.4 Policy Implications

Inflation surveillance should distinguish the direction of exchange-rate movements. Authorities need to separate depreciation from appreciation episodes and monitor the imported content of major CPI components. An improvement in the official exchange rate alone is not sufficient evidence that retail prices will decline quickly, particularly when import contracts, replacement costs, and distribution margins adjust with delay.

Oil booms create room to strengthen fiscal and foreign-exchange buffers rather than commit to expenditure paths that are difficult to reverse. The long-run association following oil-price declines implies that a downturn may generate inflation pressure through revenue, liquidity, and exchange-rate channels even as direct energy costs fall. Fiscal, monetary, and exchange-rate management should therefore be coordinated rather than responding separately to a single observed price movement.

Targeted transfers are preferable to broad measures that suppress price signals while generating persistent fiscal costs. Over a longer horizon, lower dependence on imported production inputs and greater transparency in exchange-rate and subsidy adjustments would reduce the channels through which external shocks become persistent pressure on consumer prices.

These results suggest that policy responses should differentiate between typical combinations of external shocks. When oil prices rise and the dinar depreciates simultaneously, building fiscal and foreign-exchange buffers and monitoring imported replacement costs becomes more appropriate than committing to expenditure paths that are difficult to reverse. Conversely, when oil prices fall, but the official exchange rate improves, authorities should anticipate that fiscal and liquidity pressures may still generate inflationary impulses through the exchange-rate channel. Coordinated exchange-rate, monetary, and fiscal decisions are therefore more robust than separate reactions to a single observed direction of movement.

7 CONCLUSIONS

Using annual data for 1987–2025, this study estimates asymmetric exchange-rate and oil-price pass-through to Algerian consumer prices within a nonlinear ARDL framework. The raw database contains 39 observations. The nonlinear partial sums begin after first differencing, and the one-period lag of the level terms sets the final EViews sample to 1989–2025 with 37 observations. EViews selects ARDL(1,0,1,0,1), and the bounds test supports a long-run level relationship.

Positive and negative exchange-rate movements produce statistically different long-run responses. Depreciation is conditionally associated with a higher consumer-price level, while the appreciation coefficient must be read together with the negative sign of its partial sum and is not a conventional elasticity. Oil-price effects are also asymmetric in the long run. Short-run oil asymmetry receives weaker support and is significant only at the 10% level.

The error-correction coefficient of -0.3927 implies that approximately 39.3% of the previous year's disequilibrium is corrected within one year. The multiplier paths remain widely separated for the exchange rate, while the smaller oil-price gap converges gradually. The reported residual and stability diagnostics do not reject their stated null hypotheses at conventional levels.

Inflation management in Algeria should account for the direction and persistence of external movements, the import structure of the economy, and the fiscal and foreign-exchange consequences of hydrocarbon-price changes. Building buffers during favourable oil periods and monitoring imported replacement costs provide a more appropriate basis for policy coordination than responses based solely on the current direction of the external shock.

The analysis remains constrained by annual frequency, the small effective sample, reliance on the official rather than the parallel exchange rate, and the use of headline CPI. It also abstracts from the distinction between oil-supply shocks, global-demand shocks, and oil-specific demand shocks. These constraints make the reported asymmetries informative about annual inflation dynamics but leave open the question of how far similar patterns extend to higher-frequency and disaggregated price indices. Future research could address these issues by combining monthly data with sectoral prices, incorporating the parallel-market exchange rate, and allowing for structural breaks or multiple nonlinear thresholds while retaining the conditional interpretation of the present estimates.

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APPENDICES

Appendix A: Full Results of the Long Run Coefficients (CEC Regression)

Appendix A reproduces the complete CEC coefficient output used to construct the long-run summary reported in the text.

Variable *	Coefficient	Std. Error	t-Statistic	Prob.
LM2	-0.082685597	0.13888539	-0.595351299	0.5561
LRGDP(-1)	-1.408056557	0.543366097	-2.591358876	0.0146
@CUMDP(LEXR)	0.780202855	0.08028156	9.718331986	0.0000
@CUMDN(LEXR)	-2.775482276	0.648053207	-4.282800001	0.0002
@CUMDP(LOIL(-1))	0.063838096	0.089186613	0.71578114	0.4797
@CUMDN(LOIL(-1))	-0.187393734	0.073926471	-2.534866478	0.0167
C	40.28152663	11.75742027	3.426051438	0.0018

Note: * Coefficients derived from the CEC regression.

Appendix B: Full Results of the Short Run Coefficients

Appendix B reproduces the EViews short-run output for the 1989–2025 estimation sample of 37 observations.

Dependent Variable: D(LCPI)
Method: ARDL
Date: 07/07/26 Time: 19:39
Sample: 1989–2025
Included observations: 37
Dependent lags: 1 (Automatic)
Automatic-lag linear regressors (1 max. lags): LM2 LRGDP
Automatic-lag dual non-linear regressors (1 max. lags): LEXR LOIL
Deterministics: Restricted constant and no trend (Case 2)
Model selection method: Akaike info criterion (AIC)
Number of models evaluated: 16
Selected model: ARDL(1,0,1,0,1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ*	-0.392671065	0.018399986	-21.34083494	0.0000
D(LRGDP)	-0.115925802	0.169306214	-0.684710847	0.4983
@DCUMDP(LOIL)	-0.085774642	0.028942721	-2.963599815	0.0056
@DCUMDN(LOIL)	0.048822313	0.026904885	1.814626355	0.0787
R-squared	0.894113	Mean dependent var		0.076910819
Adjusted R-squared	0.884487	S.D. dependent var		0.075278924
S.E. of regression	0.025585205	Akaike info criterion		-4.39179914
Sum squared resid	0.021601889	Schwarz criterion		-4.21764586
Log likelihood	85.24828414	Hannan-Quinn criter.		-4.33040195
F-statistic	92.88438304	Durbin-Watson stat		1.817516622
Prob(F-statistic)	0.000000			

* p-values are incompatible with t-Bounds distribution.

Appendix C: Full Results of Wald Test for Asymmetry

The three Wald outputs correspond to the long-run exchange-rate, long-run oil-price, and short-run oil-price restrictions reported in the main text.

Table C1. Long Run Asymmetry Test for Exchange Rate (LEXR)

Wald Test:			
Equation: Untitled			
Test Statistic	**Value**	**df**	**Probability**
t-statistic	6.085282213	26	0.0000
F-statistic	37.03065961	(1, 26)	0.0000
Chi-square	37.03065961	1	0.0000
Null Hypothesis: C(4) = C(5)			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		**Value**	**Std. Err.**
C(4) - C(5)		1.396214669	0.229441235
Restrictions are linear in coefficients.			

Table C2. Long Run Asymmetry Test for Oil Price (LOIL)

Wald Test:			
Equation: Untitled			
Test Statistic	**Value**	**df**	**Probability**
t-statistic	3.894225588	26	0.0006
F-statistic	15.16499293	(1, 26)	0.0006
Chi-square	15.16499293	1	0.0001
Null Hypothesis: C(6) = C(7)			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		**Value**	**Std. Err.**
C(6) - C(7)		0.09865147	0.025332757
Restrictions are linear in coefficients.			

Table C3. Short Run Asymmetry Test for Oil Price (LOIL)

Wald Test:			
Equation: Untitled			
Test Statistic	**Value**	**df**	**Probability**
t-statistic	-1.990538859	26	0.0571
F-statistic	3.962244951	(1, 26)	0.0571
Chi-square	3.962244951	1	0.0465
Null Hypothesis: C(10) = C(11)			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		**Value**	**Std. Err.**
C(10) - C(11)		-0.134596955	0.067618351
Restrictions are linear in coefficients.			