International Food and Oil Price Pass-through and Inflation Dynamics in Algeria: Evidence from VAR Models and Wavelet Coherence Analysis

Fatih Chellai[1] | *Ferhat Abbas University, Setif, Algeria*

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Abstract

This study examines how international oil and food prices affected domestic inflation in Algeria from 1994 to 2022. Using advanced time-series methods and spectral analysis, we provide updated evidence on how global price shocks influence Algeria's consumer prices. The results from vector autoregression (VAR) models with structural breaks show that Algeria's inflation is strongly influenced by external supply-side factors, particularly food prices, while exchange rate pass-through and domestic demand pressures remain weak. Wavelet coherence analysis highlights how the relationship between global and domestic prices changes over time, with strong short-term connections but weaker long-term ones. Our findings reveal Algeria's high exposure to imported inflation due to its dependence on oil and food imports, though recent institutional reforms have created more room for stabilization policies. This study fills gaps in the literature by exploring price transmission dynamics during major global shocks, including the COVID-19 pandemic, and offers guidance on managing inflation risks in a volatile global economy.

Keywords	***DOI***	***JEL code***
Price transmission, inflation, international commodity prices, Vector Auto-regression (VAR) models	*https://doi.org/10.54694/stat.2024.68*	*E31, F62, Q43, C50*

INTRODUCTION

The relationship between international commodity prices and domestic inflation is critical, particularly for developing economies reliant on food and energy imports or exports (Calvo, 2008). For Algeria, an oil-exporting country importing over 70% of its food consumption (FAO, 2022a), global price

[1] Ferhat Abbas University, EL Baz Campus, Sétif, Algeria. E-mail: fatih.chellai@univ-setif.dz, phone: (+213)0663526184. ORCID: <https://orcid.org/0000-0002-3249-846X>.

fluctuations significantly impact consumer prices and macroeconomic stability. In 2022, Algerian inflation reached 9.3%, driven primarily by rising food prices (World Bank, 2023). This underscores the welfare and economic insecurity challenges posed by soaring commodity costs. However, empirical studies on the pass-through of international food prices to Algerian domestic prices remain scarce.

Given this background, the recent COVID-19 pandemic and Russian invasion of Ukraine represent global shocks that have caused major fluctuations in commodity prices, disrupting supply chains worldwide (Saha et al., 2022; OECD, 2021). However, existing literature on the transmission of international food and oil prices to domestic prices in Algeria is based on pre-pandemic data, with studies by Lacheheb and Sirag (2019). Mohammed et al. (2018), and Bouchaour and Al-Zeaud (2012) all examining periods prior to 2020. Algeria saw significant spikes in domestic food inflation during both the pandemic and following Russia's invasion of major wheat exporter Ukraine in February 2022 (FAO, 2022b). Examining price transmission in Algeria through 2022, encompassing both the COVID-19 pandemic and Ukraine war, would provide valuable evidence on whether and how major global shocks alter domestic price dynamics.

This study employs a combination of vector autoregression (VAR) models and wavelet coherence analysis to examine the transmission of international food and oil prices to domestic prices in Algeria. VAR models are well-suited to analyzing multivariate time series relationships and have been extensively applied in price transmission research (Zivot and Wang, 2006). However, these models assume linear relationships that may not fully capture real-world complexities. Wavelet analysis provides a complementary time-frequency approach that can isolate short, medium, and long-run co-movements between time series across different time horizons (Cazelles et al., 2008). In particular, wavelet coherence analysis can quantify localized correlations and lead/lag relationships in a statistically rigorous manner (Torrence and Compo, 1998).

H1: Increases in international food and crude oil prices will have a significant positive pass-through effect on domestic consumer price inflation in Algeria.

A number of theoretical models suggest that increases in world commodity prices can transmit to higher domestic inflation, especially in emerging markets that are more vulnerable to external shocks (Calvo, 2008). Empirically, several studies have documented significant positive pass-through relationships from global food and oil prices to domestic inflation across developing economies (Ibrahim, 2015). Even for commodity exporters, indirect effects through wages, exchange rates and production costs can drive up prices. Given Algeria's heavy reliance on imported food (~70% of domestic consumption) and its status as a major oil exporting economy (FAO, 2022b; OPEC, 2022), shocks to world food and oil markets can significantly impact domestic inflationary dynamics.

H2: The pass-through impact will be larger and more immediate for international food price shocks compared to oil price shocks.

Since Algeria is a net oil exporter, global oil price hikes directly raise export revenues and government spending capacity, dampening inflationary effects (IMF, 2011). But for food that is predominantly imported, global price rises quickly feed into domestic costs and prices (Arndt et al., 2008).

H3: The exchange rate channel will be an important transmission mechanism in addition to direct imported inflation effects.

Previous studies highlight the significant impact of exchange rate changes on domestic prices, particularly in import-dependent developing countries (Choudhri and Hakura, 2006; Oyinlola and Egwaikhide, 2011). Currency depreciation raises the cost of imports, amplifying external price shocks. Algeria's reliance on imported food and industrial inputs makes the exchange rate a critical transmission channel (IMF, 2023). With a managed float exchange rate tied to oil revenues, dinar volatility contributes to domestic inflation

(Ali et al., 2018). This study tests the role of exchange rate variations in external price transmission using a VAR model, while including control variables such as the GDP growth, money supply, and exchange rates, recognized as key inflation determinants (Williams and Adedeji, 2004; Amassoma et al., 2018).

This paper is structured as follows: Section 1 reviews literature on price transmission and time series models; Section 2 outlines the methodology, including VAR modeling and wavelet analysis; Section 3 presents the empirical results, including VAR estimates and wavelet coherence outcomes; Section 4 discusses economic implications and policy recommendations; and the final section concludes with a summary, limitations, and future research directions.

1 LITERATURE SURVEY

Several studies have analyzed the transmission of international food and commodity prices to domestic markets, especially for developing countries. Bekkers et al. (2017) found heterogeneous price transmission elasticities across different food categories using a panel error correction model for 143 countries. Transmission was greater for internationally traded foods compared to non-tradables. Selliah et al. (2015) focused specifically on Sri Lanka, finding wheat and maize prices strongly co-moved with global prices. Dawe et al. (2015) similarly found increased pass-through to domestic markets for over a dozen developing countries during the 2007–2008 episode. On transmission mechanisms, Belke and Dreger (2015) applied cointegration analysis to North African countries, determining exchange rates amplified external food price shocks.

Lee and Park (2013) used a panel VAR model to analyze Asia-Pacific countries, while Ianchovichina et al. (2014) simulated oil and grain price impacts across the Middle East and North Africa. Cudjoe et al. (2010) examined household welfare effects of price transmission in Ghana. Other literature has investigated macroeconomic implications. Catão and Chang (2015) found food price inflation significantly predicted monetary policy responses across developing countries. Recent studies have continued examining transmission dynamics. Elleby and Jensen (2019) found economic development dampened farm-retail price transmission globally from 1990–2015. Dillon and Barrett (2016) showed local food prices in Kenya and Uganda responded more to global oil than food prices. Aday and Aday (2020) reviewed how COVID-19 disrupted global food supply chains and increased volatility.

The use of monthly or quarterly data in most studies may not fully capture longer-run dynamics (Selliah et al., 2015). Most focus on major cereal and food commodities, with less attention to processed foods or fuel prices (Belke and Dreger, 2015; Lee and Park, 2013). Country-specific studies provide greater policy relevance but lack generalizability (Cudjoe et al., 2010; Ianchovichina et al., 2014). Co-movement and correlation analysis is common but does not prove causality (Dawe et al., 2015; Dillon and Barrett, 2016). Endogeneity issues between macroeconomic controls and inflation are often unaddressed. There is limited application of advanced time series analysis; VAR and cointegration techniques dominate (Bekkers et al., 2017).

From a macroeconomic perspective, prior evidence indicates substantial impacts on Algerian inflation stemming from fluctuations in oil prices given Algeria's high economic dependence on hydrocarbons (Lacheheb and Sirag, 2019; Brini and Jemmali, 2016; Bouamra et al., 2023). For instance, using a nonlinear auto-regressive approach, Bouamra et al. (2023) find asymmetric effects from oil volatility whereby negative shocks exert larger impacts on inflation. Concentrated terms of trade exposures also transmit oil and food price escalations directly to consumer budgets and broader costs in Algeria (Bala and Chin, 2018; Bouchaour and Al-Zeaud, 2012). Mohammed et al. (2015) thus emphasize oil prices among primary macro drivers of inflation in time-series modeling.

This study addresses key gaps by utilizing annual data spanning almost three decades in conjunction with sophisticated wavelet-based techniques to capture both temporal and frequency domain dynamics. Combined with rigorously specified VAR models, the paper provides more definitive empirical quantification along with novel time-frequency insights into price transmission-inflation linkages in Algeria shaped by changing trade exposures, procyclical fiscal policies, real undervaluation, negative oil shocks and gradual institutional improvements.

2 METHODS

In this study, we leverage the Vector Autoregressive (VAR) model, a robust multivariate time-series analysis technique, to capture the dynamic interactions among key variables. The VAR model facilitates a comprehensive exploration of temporal dependencies, offering valuable insights into the interconnected behavior of the studied phenomena. Additionally, we employ wavelet analysis, a powerful tool for time-frequency domain exploration, to unveil nuanced patterns and correlations within the data.

2.1 Vector Autoregressive (VAR) model

A VAR model with k endogenous variables has the following structural form:

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + u_t, \tag{1}$$

where: y_t is a $(k\times1)$ vector of endogenous variables, c is a $(k\times1)$ vector of constants. $A_1, A_2, \dots, A_p$ are $(k\times k)$ coefficient matrices; u_t is a $(k\times1)$ vector of structural disturbances with $E(u_t) = 0$ and $E\left(u_t\, u_t^{`}\right) = \Sigma_u$. Each equation is estimated using OLS methodfor parameters estimates.

2.1.1 Impulse Response Analysis

Impulse Response Analysis examines how a system reacts to a shock in one variable over time using a VAR model.

$$IRF_t = A_1 IRF_{t-1} + A_2 IRF_{t-2} + \dots + A_p IRF_{t-p}, \tag{2}$$

where: IRF_t is a vector representing the response of variable y_j at time t. Where $IRF_{t-1}, IRF_{t-2}, \dots, IRF_{t-p}$, represent the responses at previous time periods.

2.1.2 Forecast Error Variance Decomposition (FEVD)

FEVD quantifies the contribution of each shock (innovation) to the variance of forecast errors in a vector autoregressive (VAR) model. The forecast error variance decomposition for a variable y_i at horizon h is defined as:

$$\text{FEVD}_i(h) = \frac{\sum_{j=1}^{n} \omega_{ij}(h)^2}{\sigma_i^2(h)}, \tag{3}$$

where: $\omega_{ij}(h)$ represents the impulse response of variable i to shock j at horizon h. $\sigma_i^2(h)$ is the forecast error variance of variable i. The sum of FEVDs for variable y_i across all variables will be equal to 1.

2.2 Continuous Wavelet Transform (CWT)

Wavelet analysis enables simultaneous examination of time and frequency domains, revealing periodicities and localized structures (Torrence and Compo, 1998; Aguiar-Conraria and Soares, 2011). Cross wavelet analysis extends this to explore relationships between two time series, highlighting regions of high common power and relative phase (Veleda et al., 2012). This makes wavelets effective for analyzing complex interactions in ecological, climate, and economic data (Cazelles et al., 2008). While they detect transient oscillations and subtle patterns proper normalization and bias correction are crucial for accurate interpretation (Veleda et al., 2012). Given a time series $x(t)$ The CWT can be defined as follows:

$$W_x(a,b)=\frac{1}{\sqrt{|a|}}\int_{-\infty}^{\infty}x(t)\psi^*\left(\frac{t-b}{a}\right)dt, \tag{4}$$

where: $W_x(a,b)$ is the continuous wavelet transform of the signal at scale a and time $b \cdot \psi^*(x)$ denotes the complex conjugate of the mother wavelet function $\psi(x)$ a is the scale parameter, which determines the width of the wavelet. b is the translation parameter, which shifts the wavelet along the time axis. The Morlet wavelet, often used in CWT, is defined as:

$$\psi(t)=\pi^{-\frac{1}{4}}e^{-i\omega_0 t}e^{-\frac{t^2}{2}}, \tag{5}$$

where: ω_0 is a dimensionless frequency parameter. The CWT is widely used in various fields, including signal processing, geophysics, neuroscience, and more, for its ability to reveal both the temporal and spectral characteristics of complex data (Mallat, 1999).

2.2.1 Wavelet Coherence Analysis

Wavelet Coherence Analysis is a method for investigating the relationships and coherence between two signals in the time-frequency domain (*i.e.* two time series). The wavelet coherence is calculated as:

$$C(a,b)=\frac{|S(a^{-1}W_{xy}(a,b))|^2}{S(a^{-1}|W_x(a,b)|^2)S(a^{-1}|W_y(a,b)|^2)}, \tag{6}$$

where: $W_{xy}(a,b)$ is the Cross-wavelet transform of the two signals. $W_x(a,b)$ and $W_y(a,b)$ represent the continuous wavelet transforms of signals $x(t)$ and $y(t)$, respectively. The wavelet coherence analysis provides insights into the time-varying correlations and phase differences between $x(t)$ and $y(t)$ across different scales and times.

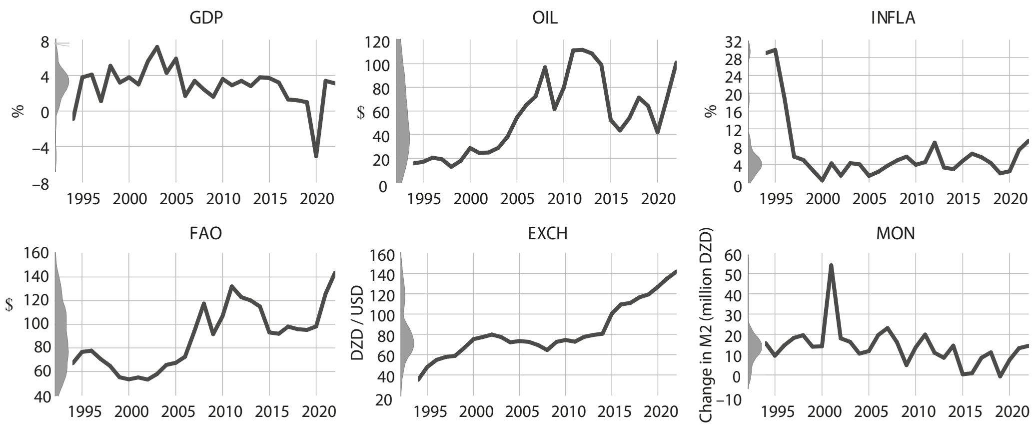
3 RESULTS

3.1 Data collection

The dataset utilized in this study has been carefully assembled to provide a comprehensive understanding of the economic dynamics in Algeria. The time series spans from 1994 to 2022, with yearly data intervals. The data collection process involves sourcing annual data from reputable institutions such as the World Bank, FAO Database, International Energy Agency (IEA), and the Central Bank of Algeria. Each variable is carefully selected based on its relevance to the Algerian economy, and the measurements are consistently reported in percentage changes or standardized units to ensure comparability. The Domestic CPI Inflation, International Food Price Index, Brent Crude Oil Price, Broad Money Supply (M2), Nominal Effective Exchange Rate, and Gross Domestic Product (GDP) are all represented with annual frequency, reflecting the broader economic landscape. All statistical analyses, including econometric and time series modeling, were conducted using a combination of R (version 4.4.2; R Core Team, 2024) and EViews (version 13; IHS Markit, 2023).

To identify structural shocks in the VAR model and isolate the effects of global food and oil price shocks on Algerian inflation, a baseline VAR may include inflation, global food prices, global oil prices, and domestic economic activity. Additional variables and a dummy for structural breaks (1994–2022) improve identification and control for macroeconomic factors. Robust data collection and careful variable selection ensure a rigorous analysis of Algerian inflation dynamics.

Figure 1 Economic indicators during 1994–2022



Source: Author's compilation

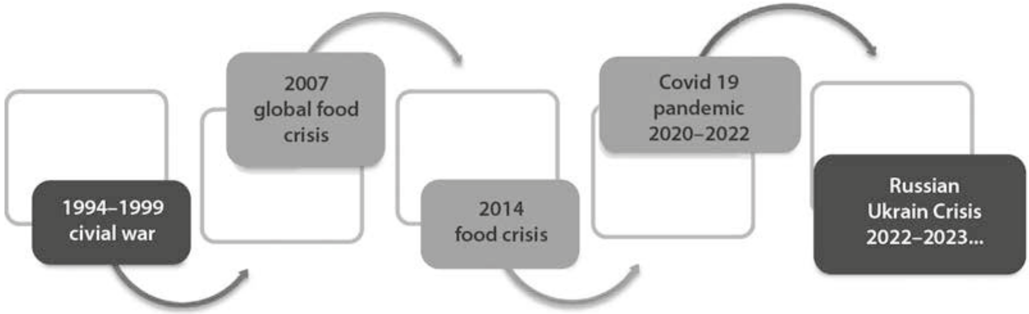
Figure 1 shows plots containing the trends, fluctuations and structural breaks evident in the time series data on food prices (FAO), exchange rate (EXCH), GDP growth, inflation (INFLA), oil prices (OIL) and money supply (MON) for Algeria from 1994 to 2022. Food prices (FAO index) display an upward trend over the period, punctuated by spikes in the late 2000s and early 2010s during global food price crises. Prices reached a peak of 143.7 in 2022 amid supply shortages. Exchange rate (EXCH) shows a gradual depreciating trend for the Algerian dinar from 35 in 1994 to 142 in 2022, indicating reduced purchasing power against major currencies. GDP growth has fluctuated cyclically, with downturns in the late 1990s due to lower oil prices, and during the global financial crisis.

3.1.1 Analyzing and investigation the shocks and crisis during the period (1994–2022)

The Algerian Civil War (1994–1999) left a lasting impact on the country's economic landscape. The conflict led to severe disruptions in various sectors, affecting both production and distribution processes. Economic activities, including agriculture and trade, were significantly hampered, creating an environment of uncertainty and instability (IMF, 1998). As a result, the pass-through effect of international food and oil prices to domestic prices during this period may have been erratic due to the economic turmoil caused by the civil war.

The 2007 global food crisis, marked by surging food prices, had widespread economic impacts. In Algeria, as a net food importer, government interventions like subsidies and trade policies mitigated the pass-through effect on domestic prices (Belhadj-Klaz, 2013). Similarly, the 2014 food crisis, driven by drought and supply chain disruptions, affected food security and prices, with emergency measures and increased imports shaping pass-through dynamics (World Food Programme, 2015; FAO, 2022b). During the Covid-19 pandemic, global demand and supply shocks disrupted commodity prices, while Algeria's lockdowns and economic disruptions influenced the pass-through effect. Fiscal and monetary policies played a key role in moderating these impacts (Chellai, 2021; World Bank, 2021).

Figure 2 Key events and structural changes in the Algerian economy (1994–2022)



Source: Author's compilation

The ongoing Russian-Ukrainian crisis introduced uncertainties in global markets, impacting oil prices and trade relations. Algeria, as an oil-exporting country, is susceptible to fluctuations in oil prices, influencing the pass-through effect (Bloomberg, 2022). Geopolitical events may prompt government interventions and policy adjustments, shaping the pass-through dynamics in the coming years. To deepen the analysis, wavelet analysis can be employed to explore how the effects of shocks propagate across both time and frequency domains, as highlighted by Gencay et al. (2001). Additionally, structural break tests, such as those proposed by Bai and Perron (2003), are valuable for identifying shifts in the data-generating process linked to these shocks.

3.2 Empirical analysis: results of VAR and Wavelet models

This section presents key results from the VAR and wavelet models analyzing the multiple channels through which international oil and food prices influence domestic inflation in Algeria. The IR analysis traces structural shock spillovers, while wavelet coherence unravels periodicity-specific information sharing.

3.2.1 Dynamic interactions: VAR model results

Determining the order of integration and structural shifts is crucial before modeling time series. This study applies the Zivot and Andrews (1992) unit root test, which accounts for an unknown single breakpoint in the trend under the null hypothesis. The test results provide p-values for levels and first differences and identify significant structural shift dates, see Table 1. At conventional significance levels, INFLA, MON, and GDP are trend stationary in levels, while FAO and EXCH require first differencing to achieve stationarity. OIL exhibits a unit root in levels at the 10% significance level based on Zivot-Andrews p-values.

Table 1 Unit root testing and structural break detection (Zivot and Andrews test, 1992)

Variables	Level	First difference	Break dates
	Prob.	Prob.	
INFLA	< 0.01	×	1996
FAO	0.01	×	2006
OIL	0.74	< 0.01	2004, 2014
EXCH	0.99	< 0.01	2015, 2016
MON	< 0.01	×	2001
GDP	< 0.01	×	2016

Note: The notation (×) indicates that the variable is stationary at the level, as confirmed by the statistical test.
Source: Author's construction

Regarding structural instabilities, clear breakpoint dates were uncovered through the tests. The 1996 shift in INFLA potentially reflects monetary policy reforms. For FAO food price index, the 2006 break likely captures biofuel demand growth effects. OIL experienced two major ruptures in 2004 and 2014 – consistent with the global oil supply glut onset. EXCH rate regime switches surfaced post-2015. The 2001 turning point for MON matches known monetary expansion.

3.2.1.1 Cointegration Analysis

The null hypothesis of no cointegration among the variables cannot be rejected, as the tau-statistics are insignificant, and rho-values are close to zero. Additionally, large residual variance relative to long-run variance confirms the lack of cointegration. Results in Table 2, showed that with six stochastic trends, the variables – oil prices, food prices, GDP, inflation, money supply, and exchange rate – do not share common drifts or a long-run relationship. This indicates no statistically significant long-run cointegration over the sample period.

Table 2 Cointegration test results

Variable	EXCH	FAO	INFLA	MON	OIL	PIB
Tau-statistic	–1.86	–3.64	–5.44	–4.80	–4.27	–5.57
Prob.	0.98	0.50	0.04	0.12	0.25	0.03
z-statistic	–8.03	13.15	–42.09	–26.45	–39.93	–28.77
Prob.	0.98	1.00	0.00	0.09	0.00	0.04
Rho – 1	–0.29	–1.24	–0.88	–0.94	–0.73	–1.03
Rho S.E.	0.15	0.34	0.16	0.20	0.17	0.18
Residual variance	159.89	23.78	9.54	84.28	65.60	3.92
Long-run residual variance	159.89	5.51	30.15	84.28	271.58	3.92
Number of lags	0	6	1	0	1	0
Number of observations	28	22	27	28	27	28
Number of stochastic trends**	6	6	6	6	6	6

Note: ** the number of stochastic trends typically refers to the maximum number of independent unit root processes (or cointegrating relationships) in a multivariate time series model.
Source: Author's compilation

It implies the VAR model may be best specified in first differences rather than levels. The finding is reasonable given Algeria faced several structural breaks over this period. However, limitations like small sample size may affect results. Consequently, the Johansen cointegration test indicates no stable long-run equilibrium between the Algerian macroeconomic variables and global commodity prices in levels. We can proceed with estimating a VAR in first differences.

3.2.1.2 Model specification

To determine the optimal lag order for capturing dynamic interlinkages between variables, the Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (BIC), and Hannan-Quinn Criterion (HQC) were used, balancing model fit and complexity with differing penalty calculations (Akaike, 1998; Schwarz et al., 1978; Hannan, 1980). Lag specifications of 1 to 2 periods were evaluated using log likelihoods and LR test p-values to assess improvements from additional lags. Lower information criteria values indicate preferred models. AIC favors a 2-period lag, while BIC suggests 1 lag. The Hannan-Quinn Criterion supports 2 lags, balancing fit and complexity. Accordingly, a VAR(2) model is employed, using first differences of all six time series to ensure stationarity, aligning with guidance for annual data.

3.2.1.3 Variance decomposition: key drivers of inflation variability

The VAR model's coefficients offer limited direct economic insight due to multivariate inter-linkages and simultaneous equation dynamics, making causal interpretation challenging. The study relies on impulse response analysis, variance decompositions.

Table 3 Variance decomposition of inflation (INFLA) across selected variables

S.E.	GDP	OIL	MON	INFLA	FAO	EXCH
1	1.87	0.00	0.00	0.00	100.00	0.00
2	2.31	0.48	0.24	10.79	66.37	12.08
3	2.63	17.90	0.91	10.91	52.57	9.80
4	2.96	21.13	1.55	12.68	46.64	11.22
5	3.19	21.21	7.35	11.51	40.32	11.79
6	3.46	27.86	9.42	9.82	35.69	10.53
7	3.52	27.89	9.06	9.76	34.45	11.82
8	3.61	28.80	9.52	9.34	33.98	11.29
9	3.68	29.44	9.20	9.08	33.47	11.92
10	3.71	29.26	9.43	9.08	33.02	12.07

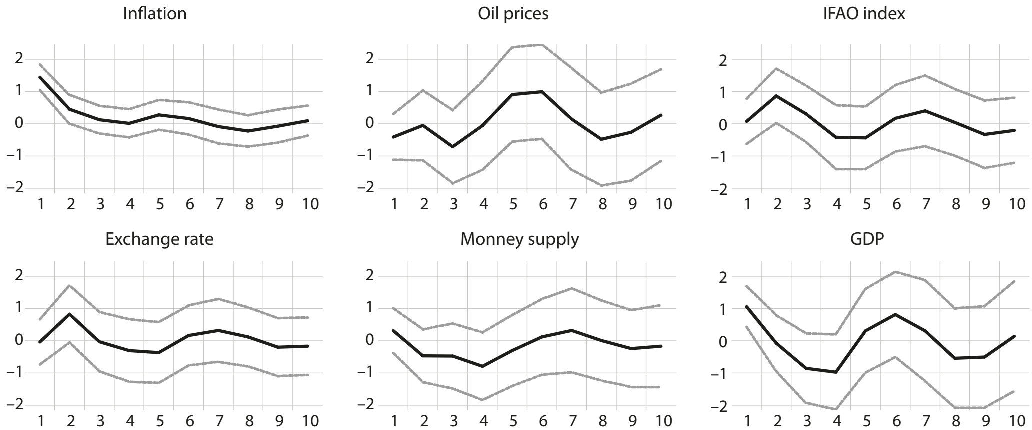
Source: Author's compilation

Table 3 presents the variance decomposition of inflation (INFLA) over a 10-period horizon, providing insights into the percentage contribution of various factors to the overall variability in inflation. Notably, during the first period, inflation is entirely explained by its own past values, representing 100% of the variance. Subsequently, the influence of other variables becomes evident, with Gross Domestic Product (GDP), Oil prices (OIL), and Monetary Supply (MON) contributing to the dynamics. Over the analyzed periods, the contributions of these factors fluctuate, highlighting the changing impact of each variable on inflation. For instance, while GDP and OIL exhibit varying contributions, Monetary Supply (MON) consistently contributes to inflation variance, suggesting its persistent influence.

3.2.1.4 Impulse response functions

The responses indicate that a positive one standard deviation unanticipated shock to oil prices leads to a marginal reduction in inflation of about 0.4 percentage points initially, see Figure 3. However, the effect turns insignificant from period 2 onwards as seen by impact oscillating around zero coupled with sizable error bands indicating poor model precision. Similarly, food price surprises (FAO shocks) and exchange rate depreciations do not elicit statistically meaningful responses from inflation according to the point estimates and confidence intervals.

Figure 3 Impulse responses of inflation to innovations in key variables in Algeria



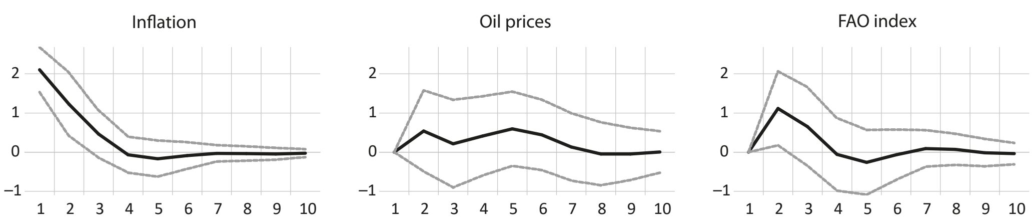
Source: Author's compilation

Money supply (MON) innovations on the contrary exert significant inflationary impacts for the first three years, with a 1 standard deviation expansionary money shock boosting inflation by around 0.3 percentage points upon impact. Finally, a positive GDP shock seems to stoke moderate inflation of 1.05 percentage points on impact, which then dies out rapidly. Likely indicating limited demand-pull pressures given economic slack and informality channels. Thus, in summary, the analysis underscores very few lasting inflationary pressures from activity or money (barring short run impact) in Algeria – rather it depends more on supply-factors like external food and oil prices outside monetary control.

3.2.1.5 Robustness analysis

To enhance the robustness of our VAR model, we conduct sensitivity analyses by excluding key variables and adding a dummy for structural changes. First, we assess the model's stability by removing GDP, Money Supply, and Exchange Rate individually. This helps evaluate the model's reliability under alternative specifications. We then introduce a dummy variable to account for structural shifts, based on significant economic events. Unlike some studies that use non-stationary time series or focus on lag-order selection (Ivanov and Kilian, 2001), we find this approach unsuitable for our analysis.

Figure 4 Inflation responses to Oil and FAO index shocks: structural break model comparison



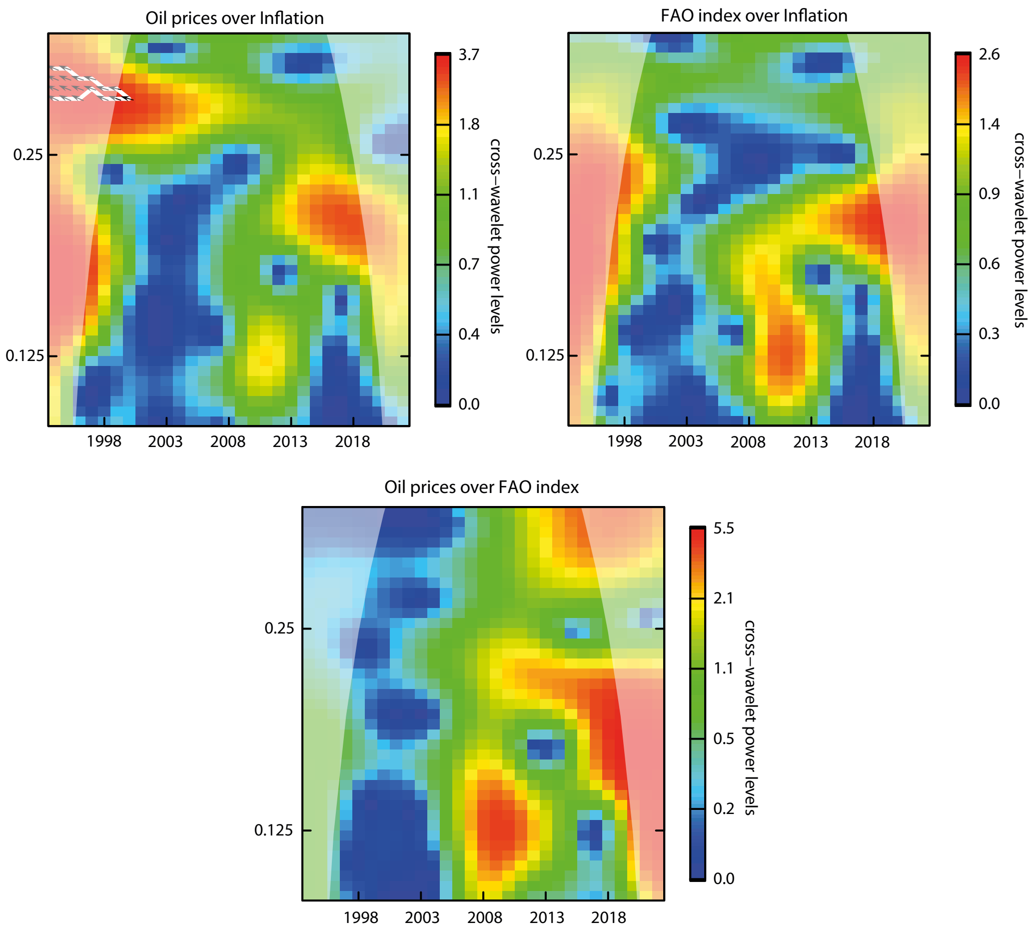
Source: Author's compilation

Oil price impacts on inflation show a diminished self-effect in the second model, with shock impact starting at 0 instead of –0.4. However, impulse trajectories remain similar, oscillating before mean-reverting, indicating strong oil-inflation responses. For food prices (FAO), the initial impact is slightly stronger with breaks, but the diminishing marginal effects from periods 2–10 remain similar. Accounting for structural changes strengthens immediate transmission but doesn't alter adjustment paths. Despite differences in point estimates, the impulse profiles' shapes and signs remain comparable, confirming the robustness of the oil-inflation linkages.

3.2.2 Frequency domain insights: Wavelet model findings

Cross wavelet coherence reveals how correlation between indicators evolves over time and across periodic cycles. The outputs illuminate the nuanced, wavelength-dependent interconnections between oil prices, food prices, and inflation in Algeria from 1994–2022.

Figure 5 Frequency domain insights: interconnections between oil prices, food prices, and inflation in Algeria (1994–2022)



Note: Red is high coherence, blue is low. Arrows indicate phase relationship.
Source: Author's compilation

The first plot examines wavelet coherence between oil prices and inflation, revealing significant correlation in the 2–4 year band during 2000 and 2011–2014, where oil price spikes directly contributed to inflationary pressures. This relationship is evidenced by in-phase patterns, indicating that rising oil prices preceded inflation during these periods. However, the coherence weakened in 2003–2005 and after 2016, suggesting a decoupling of oil prices and inflation, likely due to other economic factors or policy interventions. The second plot analyzes coherence between oil prices and the FAO Food Price Index, showing strong short-term links (1–2 years) from 2003–2012, where rising oil prices led to higher food prices, likely due to increased transportation and production costs. Interestingly, an anti-phase relationship emerged in 2016–2018, where falling oil prices coincided with rising food prices, reflecting Algeria's reliance on oil revenues to finance food imports. The third plot explores coherence between the FAO Food Price Index and inflation, highlighting short-term connections in 2001–2004 and 2010–2014, where global food price shocks drove domestic inflation. However, weaker coherence in 2005–2009 and post-2016 indicates that domestic factors or policies played a more dominant role in shaping inflation during these periods. Overall, these findings emphasize the complex, non-linear, and context-dependent relationships between oil prices, food prices, and inflation in Algeria, with their interactions varying across time and periodicities.

4 DISCUSSION

This study offers new insights into the transmission mechanisms between international oil and food prices and domestic inflation in Algeria. It combines VAR models to capture lag dynamics with wavelet coherence to reveal the temporal co-movement between global drivers and local inflation. The spike in global food prices (FAO index) during 2010–2011 reflects disruptions to agricultural production and supply chains from the 2007–2009 global financial crisis and recession, which reduced investment in agriculture and caused panic buying. Food prices moderated between 2012 and 2019 amid global recovery efforts, before rising again in 2020–2022 as the COVID-19 pandemic triggered fresh supply chain bottlenecks and demand-supply imbalances (UNCTAD, 2021). The collapse in international oil prices (OIL) in 2008–2009 was driven by weakened global demand during the global recession, as restrictive policies reduced output and investment sharply in major economies. The severe contraction in Algeria's GDP growth (PIB) in 2020 by –5.1% was a result of lockdowns, travel restrictions, and global demand destruction resulting from the COVID-19 pandemic which disrupted domestic production and exports (World Bank, 2021). Inflation (INFLA) peaked at 8.9% in 2021 in Algeria as the pandemic-induced supply shocks drove up import costs, exacerbated by loose monetary policy during the crisis (Chellai, 2021).

The variance decomposition results indicate that domestic economic activity explains the largest proportion of forecast error variance in Algerian inflation in the long-run, accounting for around 29% at the 10 quarter horizon. This finding aligns with previous studies such as (Smith, 1999) who similarly found real GDP growth and output gap measures to be significant drivers of inflation for small open economies. The strong role of domestic cyclical factors as drivers of Algerian inflation variance points to the importance of managing demand-side pressures in maintaining price stability. Shocks to international food prices were found to explain approximately 12% of long-run inflation variance. This moderate but statistically significant pass-through effect is consistent with the estimates of previous studies on emerging markets by (Lee and Park, 2013).

Global oil price shocks accounted for around 9% of forecast error variance in Algerian inflation. However, the non-trivial contribution of oil prices points to risks from export revenue fluctuations that can indirectly transmit to prices via government spending, wages and exchange rates (Nusair, 2019). Overall, the results highlight the exposure of Algerian inflation to shocks from global food and energy markets alongside domestic macroeconomic factors. This has implications for the optimal monetary and fiscal policy mix as discussed by various authors (Aliyev, 2023). The Central Bank of Algeria needs to closely monitor world commodity prices and preemptively adjust policies to contain second-round effects of external price shocks on domestic inflation.

The cross wavelet analysis results provide new insights into the complex relationships between oil prices, food prices, and inflation in Algeria from 1994 to 2022. The findings reveal that oil prices impacted both food prices and inflation during certain volatility periods, including the early 2000s oil crisis and 2011 Arab Spring, with lags of 1–3 years. This aligns with Lacheheb and Sirag's (2019) study showing oil price rises preceded consumer price inflation in Algeria during 2002–2015. However, the current findings show these coherences attenuate or disconnect over certain timeframes, indicating exogenous elements moderate the interplays, aligning with Aloui et al. (2022)'s determinations that political and fiscal overhauls transformed the oil-inflation nexus in Saudi Arabia. Furthermore, the wavelength dependence highlights nuances within periodicities. The tight oil-food coupling in the 1–2 year band underscores how oil revenue fluctuations can directly impact Algeria's import-dependent food supply (Pal and Mitra, 2017). Meanwhile, the looser coupling at longer periodicities implies inflationary inertia and other macroeconomic forces dilute oil's effects (Adeosun et al., 2014).

This study employs cross wavelet analysis to uncover unique time-frequency insights into the intricate and evolving relationships between oil, food, and inflation in Algeria. The results highlight significant empirical dependencies while cautioning against oversimplified assumptions, emphasizing the need for holistic models that consider political and external influences. Future research should examine other oil-exporting economies to identify broader patterns. Limitations include the wavelet analysis being confined to periodicities under five years, leaving room to explore longer-term cycles and sub-national trends for deeper insights. While this study provides a solid framework for understanding Algeria's oil-food-inflation dynamics, more comprehensive data and advanced models are essential for developing effective resilience strategies.

CONCLUSION

This study aimed to model the transmission of international food and oil price shocks to domestic consumer inflation in Algeria from 1994–2022. The rationale was Algeria's heavy reliance on food imports and oil exports leaves its economy vulnerable to global commodity market swings. However, existing literature focused on pre-pandemic era, necessitating updated empirical analysis. The analysis deployed multivariate VAR frameworks accommodating structural breaks plus time-frequency wavelet tools to provide comprehensive insights into price transmission channels and causal mechanisms impacting local inflation across cycles. The results confirm significant short-term pass-through from global food and oil prices to Algerian CPI, with stronger coupling to food prices. Exchange rate effects were limited. Wavelet analysis highlighted regime shifts and varying linkages over time. The findings emphasize Algeria's sensitivity to external supply shocks, while demand pressures remain weak. Institutional improvements, demand management, and fiscal stabilizers are crucial for smoothing volatility. This study fills gaps in price transmission resilience during the pandemic and offers updated insights for policymakers. Future research should expand commodity coverage, enhance models, and use higher-frequency data.

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