REGIME-DEPENDENT EFFECTS OF PUBLIC SPENDING IN ALGERIA: A STRUCTURAL VAR AND MARKOV-SWITCHING APPROACH

Fatih CHELLAI

Ferhat Abbas University, Department of Basic Education, Sétif, Algeria
ORCID ID: 0000-0002-3249-846X, E-mail: fatih.chellai@univ-setif.dz; chellai.fatih@yahoo.com

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ABSTRACT

Purpose - This study examines the macroeconomic effects of public spending in Algeria between 2000 and 2023, focusing on its role in growth, inflation, and employment within a resource-dependent economy. The research investigates how fiscal shocks, under different economic regimes, shape Algeria's structural vulnerabilities and development trajectory. Design/methodology/approach – A Structural Vector Autoregressive (SVAR) model is employed to identify and analyze the transmission of fiscal shocks on GDP, inflation, and unemployment, with oil prices treated exogenously. To capture nonlinearities and regime-dependent behaviors, a Markov-Switching VAR (MS-VAR) framework complements the baseline model. Impulse response functions and variance decomposition are used to assess dynamic interactions. Findings – Results indicate that public spending generates short-term GDP gains, reduces unemployment, and induces inflationary pressures, but these effects are highly contingent on oil revenues. Regime-switching dynamics reveal that fiscal multipliers are stronger in stable periods and weaker during volatile or crisis regimes. Algeria's persistent exposure to high-volatility regimes underscores structural fragility and fiscal dependence on hydrocarbons. Research limitations/implications - The analysis is limited by annual data availability and the specific modeling assumptions of SVAR/MS-VAR frameworks. Future studies could integrate sectoral expenditure data and higher-frequency series to enrich the robustness of findings. Practical implications – The findings stress the need for countercyclical fiscal buffers, diversification of revenue sources, and governance reforms to reduce oil dependency. Effective fiscal policy in Algeria requires adaptive frameworks that account for regime shifts and external shocks. Originality/value – This study enriches the literature on fiscal policy in rentier economies by combining SVAR and regime-switching approaches, highlighting the state-contingent nature of fiscal multipliers. It provides actionable insights for policymakers aiming to balance stabilization, growth, and resilience in volatile economic environments.

Keywords: Public expenditure; Economic growth; SVAR; Oil price; Fiscal policy

JEL Codes: E62; C32; O55; Q43

INTRODUCTION

The relationship between public expenditure and economic performance remains a cornerstone of macroeconomic inquiry, particularly for resource-dependent and developing economies. Governments frequently resort to fiscal tools not only to stabilize the business cycle but also to support long-term development objectives, especially in economies that exhibit structural vulnerabilities (Perotti, 2005; Fragetta & Melina, 2011). In rentier states such as Algeria, public expenditure is both a driver of aggregate demand and a vehicle for distributing hydrocarbon rents, reinforcing its centrality in shaping economic trajectories (Chellai, 2021; Daoudi, 2023).

The theoretical foundations of fiscal policy's impact trace back to Keynesian economics, which advocates expansionary fiscal policy during economic downturns to stimulate output and reduce unemployment. More recent frameworks, including New Keynesian and post-Keynesian models, emphasize the role of fiscal multipliers and automatic stabilizers, especially when monetary policy space is limited (Auerbach & Gorodnichenko, 2012). However, contemporary research underscores that the long-run effects and overall efficacy of government spending are critically dependent on the efficiency of public expenditure and the presence of sound fiscal rules (Apeti, Bambe, & Combes, 2025; Antolin-Diaz & Surico, 2025). Structural VAR (SVAR) models have emerged as indispensable tools in this context, enabling researchers to isolate and identify fiscal shocks while accounting for the endogenous structure of the economy (Amisano & Giannini, 1997; Lütkepohl & Velinov, 2016). This methodology is widely applied in contemporary literature to assess the impact of budget expenditures on GDP dynamics across various economic contexts (Matveev & Sokolov, 2024).

The COVID-19 pandemic and subsequent geopolitical crises — notably the 2022 Russia–Ukraine conflict — have reshaped the global economic order, revealing the fragility of global supply chains and the asymmetries in fiscal capacity across nations (Fernandes, 2020; Bakar & Rosbi, 2020). These shocks underscore the urgency of re-examining the resilience of public finance systems in countries like Algeria, where fiscal space is closely tied to oil and gas exports. This global context has amplified the focus on how fiscal policy, particularly public investment, can be engineered to foster structural economic change and enhance regional resilience (Zezza & Guarascio, 2024).

In this light, Algeria presents a compelling case for empirical exploration. Between 2000 and 2023, the Algerian economy experienced substantial volatility due to exogenous oil price shocks, global crises, and domestic structural constraints.

Yet, it also navigated key opportunities to recalibrate its fiscal trajectory, particularly in the post-2020 period when energy prices surged following the outbreak of war in Ukraine. These developments accentuate the need to reassess the macroeconomic effectiveness of fiscal policy, particularly through the lens of a structural econometric framework.

This study employs a Structural Vector Autoregressive (SVAR) model to explore the transmission mechanisms of public spending on key macroeconomic variables in Algeria — namely, GDP, inflation, unemployment, and public expenditure — while accounting for the exogenous influence of international oil prices. Building upon recent work by Zezza & Guarascio (2024), Cărăușu & Lupu (2023), and Matveev & Sokolov (2024), this research not only contributes to the literature on fiscal policy effectiveness but also offers practical insights for Algerian policymakers navigating an era of heightened geopolitical and economic uncertainty.

Historically, numerous studies have explored the relationship between public spending and economic growth. Keynesian theory, for example, suggests that an increase in government spending can stimulate aggregate demand and, consequently, output and employment, particularly in times of recession. However, other schools of thought warn of potential crowding-out effects, where public spending could crowd out private investment, or generate inflationary pressures if not managed prudently. The empirical literature on this subject is vast, and results vary considerably depending on the countries, periods studied and methodologies employed. For example, Afonso and Gonçalves (2020) examined fiscal policy in the US and EMU, while Akpan and Atan (2015) analyzed the macroeconomic effects of fiscal policy shocks in Nigeria, both using SVAR approaches. These studies highlight the complexity of the relationship and the need for in-depth contextual analysis.

In the Algerian context, the period 2000-2023 is particularly relevant for such an analysis. This period was marked by oil price boom and bust cycles, as well as government efforts to diversify the economy and promote sustainable development. Understanding how public spending interacted with these dynamics is essential for formulating more resilient and effective economic policies in the future. The use of a Structural Autoregressive Vector (SVAR) model is justified by its ability to identify structural shocks and analyze their dynamic effects on macroeconomic variables, thus offering a more nuanced perspective than traditional models which do not distinguish between structural and reduced shocks (Amisano & Giannini, 1997). This approach will make it possible to decompose shocks and assess the specific impact of public spending on GDP, inflation and unemployment in Algeria, taking into account the specificity of its rentier economy. This study will thus contribute to the existing literature by providing empirical evidence specific to the Algerian case, which is crucial for policymakers seeking to optimize resource allocation and promote sTable, inclusive economic growth.

LITERATURE REVIEW

The relationship between public spending and economic performance is a vast and complex area of research, having been the subject of numerous theoretical and empirical studies. This section explores the main contributions of the literature, focusing on relevant theoretical frameworks, varied empirical results, and the application of SVAR models in this context.

Several economic theories attempt to explain the impact of public spending on economic activity. Wagner's law postulates a positive relationship between economic growth and increased public spending, arguing that economic development leads to increased demand for public services. Conversely, Peacock and Wiseman's theory suggests that public spending increases in stages in response to social or political shocks, and then remains at a higher level. From a Keynesian perspective, public spending can stimulate aggregate demand, particularly during periods of underemployment, leading to a multiplier effect on national income. However, classical and neoclassical economists warn of the crowding-out effect, where increased public spending financed by borrowing can raise interest rates and reduce private investment. Endogenous growth theory includes public spending, particularly on education, health and infrastructure, as factors that can improve productivity and stimulate long-term growth.

Empirical findings on the impact of public spending on economic growth, inflation and unemployment are mixed, and often depend on the specific context (country, period, type of spending). Several studies have used VAR (Vector Autoregressive) and SVAR (Structural Vector Autoregressive) models to analyze these relationships. SVAR models are particularly wellsuited because they can identify structural shocks (e.g., a fiscal policy shock) and analyze their dynamic effects on macroeconomic variables, unlike reduced VAR models, which do not distinguish between structural and reduced shocks (Amisano & Giannini, 1997).

For example, Afonso and Leal (2019) examined fiscal multipliers in the eurozone using SVAR analysis, showing varying effects across countries and expenditure types. Akpan and Atan (2015) applied an SVAR approach to study the macroeconomic effects of fiscal policy shocks in Nigeria, an economy also dependent on natural resources, finding significant impacts on GDP and inflation. Similarly, Rodríguez (2018) analyzed the dynamic effects of public spending shocks in the US, while Deleidi and De Lipsis (2018) also used an SVAR approach for fiscal multipliers in the US.

With regard to inflation, Nguyen (2019) studied the impact of public spending on inflation in emerging Asian economies, while Asandului et al. (2021) examined the asymmetric effects of fiscal policy on inflation and economic activity in post-communist European countries. These studies highlight the complexity of transmission channels and the need to consider the institutional and structural specificities of each economy.

In the context of natural-resource-dependent economies such as Algeria, the literature highlights the importance of fluctuations in commodity prices. Mendoza (1995) analyzed the impact of terms of trade on economic fluctuations, a crucial aspect for oil-exporting countries. Oil revenues can influence the government's ability to spend, and the volatility of these revenues can lead to macroeconomic instability. Chellai (2021) specifically studied the impact of government spending shocks on macroeconomic variables in Algeria using SVAR models, highlighting the relevance of this approach to the Algerian context. Daoudi (2023) also examined the impact of fiscal policy on economic growth in Algeria using a SVAR model, reinforcing the relevance of this methodology for the Algerian case.

SVAR models have become a standard tool for macroeconomic policy analysis. They overcome the limitations of reduced VAR models by imposing restrictions based on economic theory to identify structural shocks. These restrictions can be short-term (contemporaneous) or long-term. Lütkepohl and Velinov (2016) discussed methods for identifying long-term restrictions via heteroskedasticity. Pfaff (2008) also provided an implementation of VAR, SVAR and SVEC models in the R package 'vars', demonstrating their practical applicability.

Variance decomposition and impulse response functions (IRFs) are key tools in SVAR analysis. IRFs visualize the dynamic response of one variable to a unit shock in another, while variance decomposition quantifies the proportion of the variance in the forecast error of one variable explained by shocks in other variables. These tools are essential for understanding the transmission channels of shocks and the interdependence between macroeconomic variables (Martin et al., 2013).

In summary, the literature review highlights the relevance of SVAR models for analyzing the impact of public spending, particularly in resource-dependent economies. Existing studies provide a solid basis for the proposed analysis, while highlighting the need for a contextual approach to understand the dynamics specific to Algeria.

METHODS

This section details the methodological approach adopted to analyze the impact of public spending on Algerian economic performance. We rely on the Structural Vector Autoregression (SVAR) model, a robust econometric technique for analyzing dynamic interdependencies between macroeconomic variables. The discussion will include the theoretical aspect of the SVAR model, the data used, and the steps involved in identifying structural shocks.

Theoretical aspects of the SVAR model

The Vector Autoregression (VAR) model is an econometric tool widely used to model dynamic relationships between several time series. A reduced VAR model is written as:

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots + A_p Y_{t-p} + u_t \quad (1)$$

Where Y_t is a vector of n endogenous variables at time t, A_0 is a vector of constants, A_i ($i = 1, 2, \ldots, p$) are matrices of coefficients $(n \times n)$, and u_t is a vector of white noise residuals with variance-covariance matrix $\Sigma_u = E[u_t u_{t'}]$.

The residuals u_t are uncorrelated in time but may be correlated with each other at time t

The SVAR (Structural Vector Autoregressive) model extends the VAR model by imposing restrictions to identify the underlying structural shocks affecting system variables. Unlike reduced shocks u_t, structural shocks ε_t are uncorrelated and have unit variance. The relationship between reduced shocks and structural shocks is given by:

$$u_t = B\varepsilon_t \quad (2)$$

where B is a matrix $(n \times n)$ of coefficients that captures contemporaneous relationships between variables.

The variance-covariance matrix of the reduced residuals is then $\Sigma_u = BB'$, where B is the Cholesky decomposition if B is lower triangular, or another form if different restrictions are imposed.

The SVAR model can be expressed in its structural form as:

$$A_0^s Y_t = A_1^s Y_{t-1} + A_2^s Y_{t-2} + \ldots + A_p^s Y_{t-p} + B\varepsilon_t \quad (3)$$

where A_0^s is a matrix $(n \times n)$ of contemporaneous relations, $A_i^s = A_0^s A_i$ for $i = 1, 2, \ldots, p$, and $B\varepsilon_t$ represents structural shocks.

The structural shocks ε_t are uncorrelated and have unit variance: $E[\varepsilon_t \varepsilon_{t'}] = I_n$

The aim of SVAR analysis is to estimate the matrix A_0^s (or B) to identify structural shocks and analyze their effects.

Identifying the SVAR model

Identifying the matrix A_0^s (or B) requires the imposition of restrictions. These restrictions can be of two types:

- **Short-term (contemporaneous) restrictions**: These are imposed on the A_0^smatrix and reflect instantaneous relationships between variables. For example, it can be assumed that a shock in one variable does not instantly affect another variable. These restrictions are often based on economic theory or institutional knowledge.

- **Long-term restrictions**: These are imposed on the cumulative impact of shocks on variables over the long term. For example, it may be assumed that a demand shock has no permanent effect on aggregate supply. These restrictions are often used to distinguish demand shocks from supply shocks.

Impulse Response Functions and Variance Decomposition

Once the B matrix has been identified, impulse response functions (IRFs) can be calculated. IRFs describe the dynamic response of each system variable to a unit shock in one of the structural shocks:

$$\text{IRF}(h) = \Phi_h B \tag{4}$$

Where Φ_h represents the coefficients of the Wold representation at the h horizon.

They allow us to visualize the trajectory of variables over time in response to specific disturbances.

Variance decomposition (VD) is another key tool, quantifying the proportion of each variable's forecast error variance explained by shocks to the other variables:

$$\text{VD}i, j(h) = \frac{\sum k = 0^{h-1} (\phi_{i,j,k})^2}{\sum_{k=0}^{h-1} \sum_{l=1}^{n} (\phi_{i,l,k})^2} \tag{5}$$

Where $\phi_{i,j,k}$ is the element (i, j) of the matrix $\Phi_k B$.

This makes it possible to determine the relative importance of each structural shock in explaining fluctuations in macroeconomic variables.

DATA

The study analyzes Algeria's macroeconomic dynamics from 2000 to 2023 using annual data in an SVAR framework. The endogenous variables include real GDP (measuring economic output), real public expenditure (capturing fiscal policy), inflation rate (CPI) (reflecting price stability), and unemployment rate (indicating labor market conditions). Additionally, oil prices (or revenues) will be included as an exogenous variable, given Algeria's hydrocarbon dependence and its influence on fiscal capacity. Data will be sourced from the Bank of Algeria, the National Statistics Office (ONS), and international institutions (IMF, World Bank), with rigorous checks for consistency and reliability to ensure robust econometric results. This setup will allow for a comprehensive assessment of how public spending and oil price fluctuations impact Algeria’s key economic indicators.

Estimation and identification procedure

The SVAR model estimation and identification procedure will follow a structured approach: First, stationarity will be tested using unit root tests (e.g., ADF), with differencing applied if necessary. Next, the optimal lag length (p) will be selected using information criteria (AIC, BIC, or HQ), followed by the estimation of the reduced-form VAR model via OLS. Structural shocks will then be identified by imposing restrictions on the contemporaneous (B) or long-term impact matrix, drawing on economic theory and Algeria-specific conditions—such as assuming public spending shocks do not instantly affect GDP or treating oil price shocks as exogenous. Cholesky restrictions will be explored initially, with alternative schemes considered for robustness. Subsequently, impulse response functions (IRFs) will analyze dynamic responses to shocks, complemented by variance decomposition (VD) to quantify each shock's contribution to forecast error variance. This methodology will elucidate the dynamics of public spending's impact in Algeria, offering insights for economic policy formulation.

RESULTS

This section presents and analyzes the main empirical results from the estimation of the SVAR model applied to the Algerian economy over the period 2000-2023. The aim is to assess the dynamics of interactions between public spending, real GDP, inflation and unemployment, while taking into account the exogenous influence of oil prices. After checking the statistical properties of the series and identifying the optimal structure of the model, we successively present the results of the diagnostic tests, the impulse response functions and the variance decomposition, in order to better understand the transmission channels of fiscal shocks and their impact on macroeconomic equilibria.

Descriptive data analysis

Over the period 2000-2023, the data reveal continuous growth in Algeria's real GDP, rising from 4,454 billion dinars in 2000 to over 8,726 billion in 2023. This growth, although steady, appears to be strongly correlated with the evolution of oil prices, which have gone through marked cycles. The spectacular rise in oil prices between 2003 and 2008 (from 28.85 to 96.94 USD) coincided with an acceleration in GDP, supported by the expansion in oil revenues. After a period of stabilization between 2011 and 2014 at around 100 USD per barrel, a sharp fall was observed in 2015 (52.32 USD), moderately impacting growth, without reversing it. It should be noted that public spending followed a continuous upward trend, rising from around 20 billion to over 44 billion, reflecting an expansionary fiscal policy, probably to support demand and cushion external shocks linked to the volatility of oil revenues.

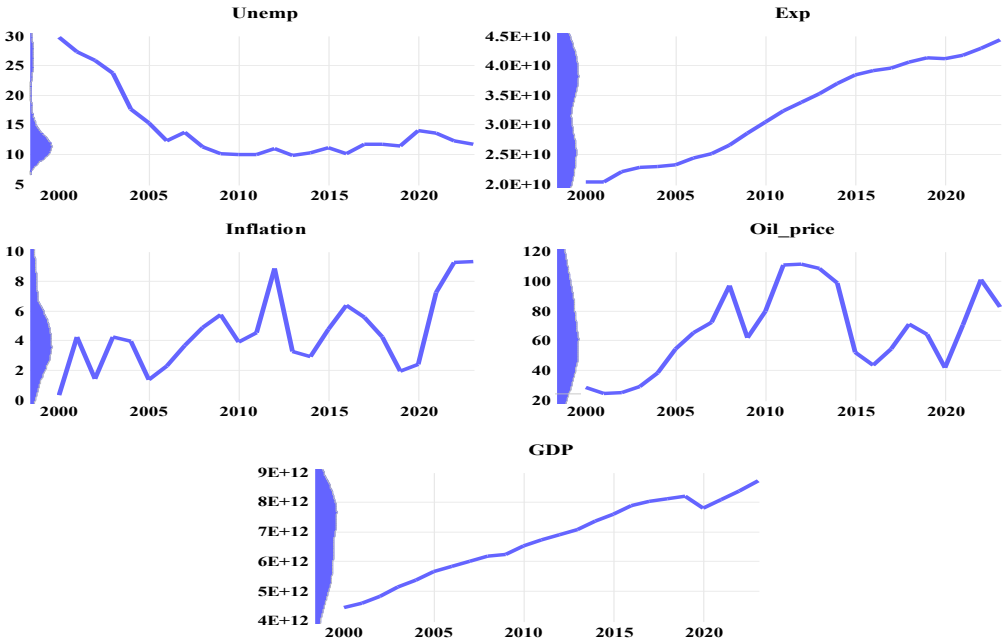

Figure1: Variable dynamics over the period (2000-2023)
Source: By author

In terms of macroeconomic imbalances, the unemployment rate fell significantly between 2000 (29.77%) and 2008 (11.33%), a period of rising oil prices and massive public investment. However, after 2009, the fall in unemployment slowed, and moderate fluctuations appeared, notably in connection with the oil crises (2015-2016) and the pandemic (2020), which pushed unemployment back up to 14.06%. Inflation, meanwhile, remains relatively unsTable, with significant peaks such as in 2012 (8.89%), 2021 (7.22%) and especially 2022-2023, when it exceeds 9%, reflecting heightened inflationary pressures in a context of external shocks, supply disruptions and perhaps accommodating monetary policy. Overall, this period illustrates the structural vulnerabilities of the Algerian economy, highly exposed to oil price fluctuations and dependent on public spending to sustain growth and contain social imbalances.

Correlation analysis between variables

The correlation matrix highlights several interesting relationships between the macroeconomic variables of the Algerian economy. Firstly, there is a strong negative correlation between the unemployment rate (UNEMP) and real GDP (LPIB) (0.792), confirming the existence of an inverse relationship between economic growth and unemployment, in line with Okun's law. Unemployment is also negatively correlated with public expenditure (EXP) (-0.710) and the price of oil (-0.726), reflecting the central role of the state and oil revenues in supporting employment in Algeria.

These correlations suggest that an improvement in economic activity or an increase in oil revenues would reduce unemployment.

Table 1: Linear correlation matrix

	Unemp	*INFLA*	*Exp*	*GDP*	*OIL_PRICE*
Unemp	1				
INFLATION	-0.414	1			
Exp	-0.710	0.534	1		
GDP	-0.792	0.546	0.983	1	
OIL_PRICE	-0.726	0.440	0.480	0.522	1

Source: By author

In parallel, we note a very high correlation between public spending and real GDP (0.983), indicating that these two variables evolve almost jointly, probably because public investment is a key driver of economic growth in the Algerian context. Moreover, public spending is moderately correlated with inflation (0.534), suggesting that fiscal policy can generate price pressures, especially when it is expansive. The positive relationship between inflation and GDP (0.546) may reflect a demand effect, albeit a moderate one. Finally, the price of oil (OIL_PRICE) shows moderate positive correlations with all the main economic variables, except unemployment. This reflects the strategic importance of oil in the national economy: increases in oil prices support budget revenues, public spending, and therefore overall economic activity. These correlations, though informal, reinforce the relevance of a dynamic analysis using VAR/SVAR models to better understand the structural interrelationships between these variables.

Variable stationarity analysis

The results of the Augmented Dickey-Fuller (ADF) unit root test indicate that all the variables - namely the unemployment rate (UNEMP), the inflation rate (INFLATION), real public expenditure (EXP), real GDP (LPIB) and the oil price (OIL_PRICE) - are not stationary in level, whatever the specification (with trend, with intercept, or without any term). In fact, the test statistics obtained at levels are well above the usual critical thresholds, which means that the null hypothesis of the presence of a unit root cannot be rejected.

Table 2: Stationarity test (ADF test)

Variable	ADF (at level)			ADF (First Diff)		
	Trend & Intercept	Intercept	None	Trend & Intercept	Intercept	None
UNEMP	0.5232	0.0102	0.0016	0.0089	0.0174	0.0022
INFLATION	0.0996	0.0747	0.5072	0.0093	0.0017	0.0001
EXP	0.9288	0.3455	0.9981	0.0363	0.0267	0.1559
LPIB	0.7590	0.1193	1.0000	0.0248	0.0239	0.0799
OIL_PRICE	0.5797	0.2847	0.5943	0.0165	0.0033	0.0002

Source: By author

On the other hand, after first differentiation, all variables become stationary, as shown by the very low values of the ADF statistics with p-values below 0.05 in all configurations. These results confirm that the series are integrated of order 1 (I(1)), which validates the use of a VAR model in first differences or a SVAR model on transformed data, while opening up the possibility, if relevant, of examining possible cointegration relationships between the variables.

Choice of optimal VAR model lag

The Table on the choice of the optimal number of lags for the model shows that lag 1 is recommended by all the statistical criteria used: the modified LR test statistic (128.50), the FPE criterion (2.14e-06), as well as the Akaike (AIC = -1.76), Schwarz (SC = -0.57) and Hannan-Quinn (HQ = -1.48) information criteria, all of which reach their minimum values at this level. This consensus between indicators suggests that the introduction of a single lag effectively captures the dynamics between variables, without overloading the model with additional lags that could lead to a loss of degrees of freedom or over-fitting. Thus, the VAR(1) model is retained as the optimal specification for dynamic analysis.

Table 3: Optimal model delay selection

Lag	*LogL*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	-44.9789	NA	0.0015	4.8163	5.2130	4.9097
1	43.3679	128.5044*	2.14e-06*	-1.760715*	-0.570487*	-1.480333*
2	53.2760	10.8089	0.0000	-1.2069	0.7768	-0.7396

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

Source: By author

Identification of structural shocks

The choice of this matrix of contemporary restrictions for the SVAR model is based on a theoretical logic consistent with macroeconomic transmission mechanisms and the institutional specificities of the Algerian economy. In this matrix, real GDP (LPIB) is placed in first position and assumed not to react to any shocks from other variables at the moment, which is economically justified by the fact that aggregate output takes time to adjust to economic shocks, especially in a country like Algeria where delays in implementing public policies and structural rigidities are frequent. Real public expenditure (EXP), on the other hand, can react immediately to the level of GDP, reflecting potentially counter-cyclical behavior on the part of the government, which adjusts its spending in line with current economic performance (e.g., higher spending in the event of slower growth). However, EXP is assumed not to react instantly to inflation or unemployment, as budgetary decisions often require a slower adjustment process, particularly in rigid institutional contexts.

Table 4: Contemporary restraint matrix

	LPIB	*EXP*	*INFLATION*	*UNEMP*
LPIB	1	0	0	0
EXP	C(1)	1	0	0
INFLATION	C(2)	C(4)	1	0
UNEMP	C(3)	C(5)	C(6)	1

Source: By author

Inflation (INFLATION) is modeled as responding immediately to shocks to GDP and government spending, reflecting the fact that any stimulation of aggregate demand (via production or government spending) can generate immediate pressure on prices, especially in an import-dependent economy like Algeria. On the other hand, it does not respond instantly to unemployment, which follows the logic of a Phillips curve that is more structural than cyclical. Finally, the unemployment rate (UNEMP) is assumed to react contemporaneously to all other variables, reflecting the labor market's direct sensitivity to changes in output, public spending (especially in an economy where the state is a major employer), and price levels. This configuration reflects the reality of the Algerian labor market, which is often influenced in the short term by public policies and the general economic situation , with little dynamic autonomy.

Estimation results for the SVAR model with A-B type identification (where $Ae=Bu$, and $E(uu')=I$) show that several contemporaneous relationships between endogenous variables are not statistically significant. The coefficients in matrix A, notably C(1), C(2), C(4), C(5) and C(6), have p-values greater than 0.05, indicating that shocks in one variable do not produce a significant instantaneous effect on the others in the model. Only the coefficient C(3), which relates unemployment to GDP, is significant ($p = 0.049$), suggesting that a shock to real GDP has an immediate and positive effect

on reducing unemployment, which is economically plausible in the Algerian context where sustained economic activity can rapidly influence demand for labor.

Table 5: Estimated matrices

	Coefficient	*Std. Error*	*z-Statistic*	*Prob.*
C(1)	-0.085	0.211	-0.401	0.689
C(2)	-27.031	22.935	-1.179	0.239
C(3)	28.289	14.344	1.972	0.049
C(4)	-0.619	22.601	-0.027	0.978
C(5)	-9.694	13.727	-0.706	0.480
C(6)	-0.023	0.127	-0.179	0.858
C(7)	0.019	0.003	6.782	0.000
C(8)	0.019	0.003	6.782	0.000
C(9)	2.068	0.305	6.782	0.000
C(10)	1.256	0.185	6.782	0.000

Source: By author

On the other hand, the coefficients of matrix B, representing the direct impact of structural shocks on the reduced residuals, are all highly significant ($p < 0.001$). This means that the structural shocks identified in the model (linked to each variable) are well differentiated and significantly explain the dynamics of the variables. More specifically, the coefficients C(7) to C(10) indicate the magnitude of the immediate impacts of the shocks specific to each variable: structural shocks to inflation and unemployment (C(9) = 2.068 and C(10) = 1.256) have stronger effects than those to GDP and public spending (C(7) = C(8) = 0.019), which may reflect the greater volatility or sensitivity of these variables in the Algerian economy.

Overall, the estimated SVAR model enables clear identification of structural shocks, although the contemporaneous relationships between some variables are not statistically robust. This can be attributed to delays in the transmission of economic policies, institutional rigidities or data quality. However, the significance of own shocks (matrix B) provides a solid basis for the analysis of impulse response functions (IRF) and variance decomposition, enabling reliable conclusions to be drawn about the transmission dynamics of shocks in the Algerian economy.

Impulse responses of macroeconomic variables to a positive shock in public spending

The impulse response functions presented in this Table describe the dynamic reaction of four Algerian macroeconomic variables (real GDP, public spending, inflation, unemployment) to a positive shock in real public spending. From the first period onwards, public spending (EXP) reacts strongly to the shock (0.0191), which is

expected, as it is the variable from which the shock originates. Then, this impulse gradually diminishes in subsequent periods, indicating a transitory effect: the fiscal shock does not maintain a continuous expansionary spending dynamic, but gradually dissipates from period 4 onwards.

Table 6: Impulse response functions of macroeconomic variables

Period	GDP	EXP	INFLATION	UNEMP
1	0.0000	0.0191	0.0118	0.1852
	0.0000	0.0028	0.4313	0.2635
2	0.0028	0.0189	0.1455	0.3793
	0.0024	0.0037	0.2266	0.2448
3	0.0051	0.0182	0.1957	0.4335
	0.0034	0.0046	0.1872	0.2566
4	0.0067	0.0172	0.2062	0.4105
	0.0039	0.0054	0.1477	0.2676
5	0.0079	0.0160	0.1960	0.3495
	0.0040	0.0059	0.1270	0.2678
6	0.0085	0.0148	0.1757	0.2749
	0.0041	0.0062	0.1165	0.2585
7	0.0087	0.0137	0.1518	0.2012
	0.0042	0.0063	0.1084	0.2436
8	0.0087	0.0126	0.1281	0.1361
	0.0042	0.0063	0.1001	0.2260
9	0.0084	0.0116	0.1068	0.0828
	0.0042	0.0063	0.0914	0.2076
10	0.0080	0.0107	0.0886	0.0418
	0.0042	0.0062	0.0829	0.1893

Source: By author

The response of real GDP is positive and increasing up to period 7, reaching a maximum of around 0.0087, before stabilizing. This reflects a positive, albeit modest, multiplier effect of public spending on economic activity. This behavior is consistent with Keynesian theories in emerging economies, where public demand plays a driving role. In the Algerian context, where the state remains the main investor and employer, a positive shock to public spending stimulates production in the short and medium term. However, the response remains weak, which could be explained by import dependency, structural rigidities and the low level of diversification in the productive fabric.

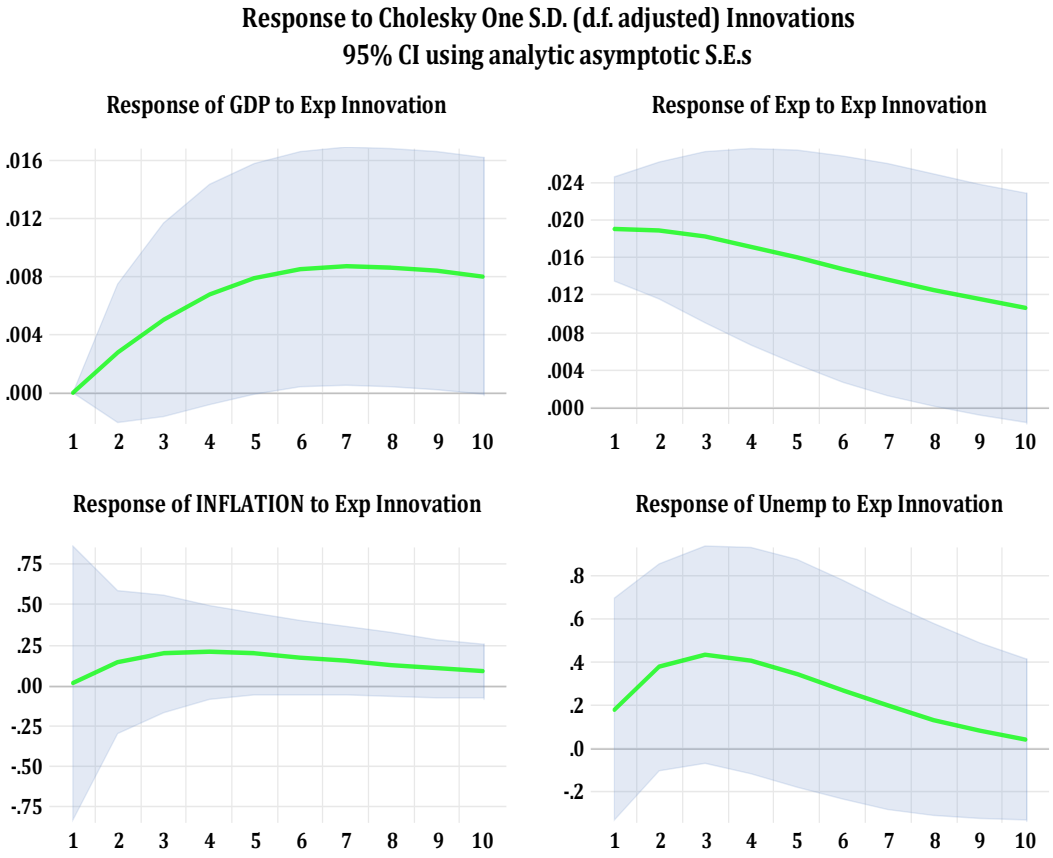

Figure 2: Impulse response function graphs
Source: By author

For inflation and unemployment, the responses are also significant. Inflation rises immediately after the shock, peaking around period 4 (0.2062), before declining slowly, indicating that public spending generates temporary inflationary pressures, probably due to an increase in demand without a proportional increase in supply. The unemployment rate, meanwhile, reacts strongly from the first period (0.1852), with a maximum response in period 3 (0.4335), before gradually decreasing. This suggests a positive effect on employment, but also a temporary one. This dynamic reflects the structure of the Algerian labor market, which is highly dependent on public recruitment and sensitive to cyclical policies, with no lasting long-term effects in the absence of structural reforms.

Variance decomposition

The variance decomposition of real GDP shows that, although it is initially entirely self-explanatory in the first period (100%), its evolution rapidly becomes influenced by other variables. By the second period, government spending explains around 1.1%

of GDP variance, while inflation explains over 7%. Over the 10-period horizon, almost 48% of GDP variation is attributed to other variables, including 28.7% to public spending, confirming their significant role in growth dynamics in Algeria, a country where public spending is a major lever of economic intervention. This supports the idea of a substantial fiscal multiplier and validates the hypothesis that government spending policies have a structuring effect on economic activity.

As regards the variance decomposition of government spending (EXP), we observe that it is mainly self-explanatory at the outset (over 99% in the first period), but its dependence on GDP and other variables increases over time. By the tenth period, around 25% of the variation in public spending is explained by other variables, mainly unemployment (9.3%) and inflation (14.1%). This result can be interpreted as a partial reactivity of public spending to the business cycle, reflecting a budgetary behavior influenced by social (unemployment) and economic (inflation) pressures, but retaining a large degree of autonomy. This profile reflects the Algerian government's budgetary stance, which is often proactive but also constrained by external factors such as price stability and the labor market.

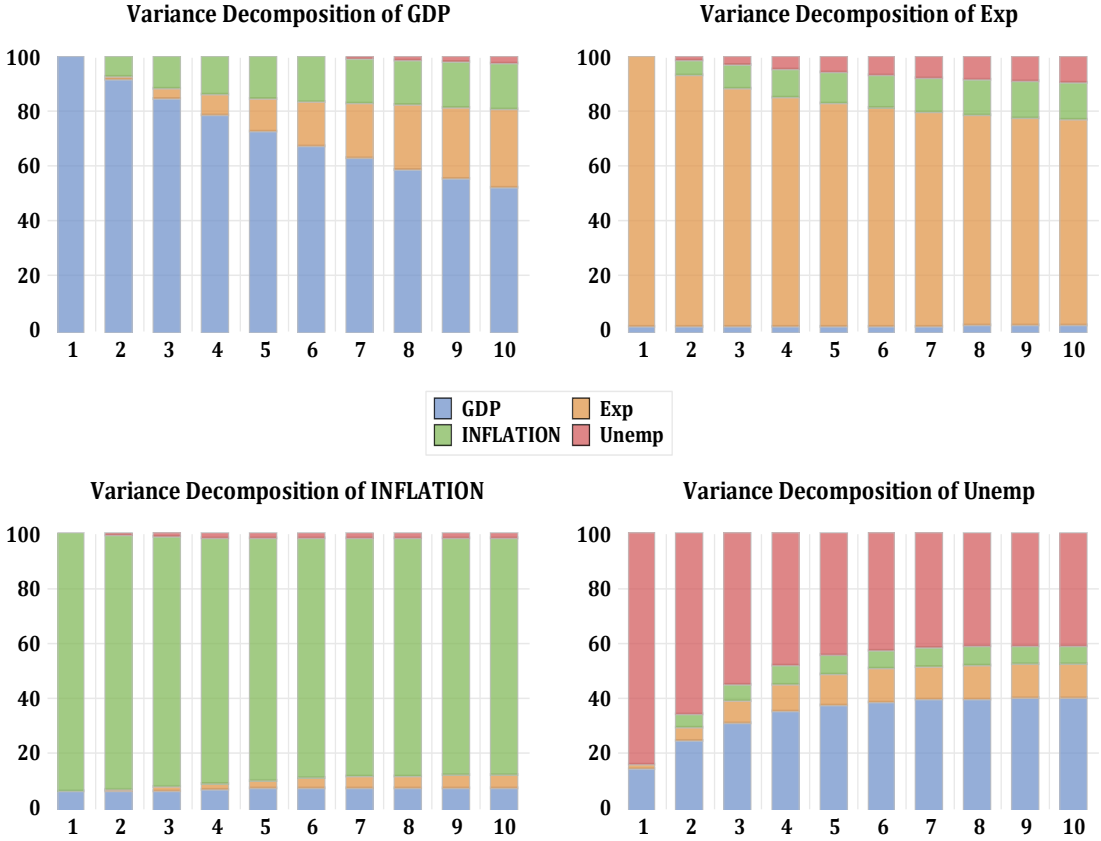

Figure 3: Variance decomposition using the Cholesky decomposition (adjusted for degrees of freedom)

Source: By author

For the INFLATION variable, the variance decomposition shows strong self-explanation from the outset (94% in period 1), but this share slowly declines to around 86.7% in period 10, indicating structural stability of inflation. However, the growing impact of public spending (4.5% in period 10) on inflation is indicative of a demand effect, probably due to the injection of liquidity via fiscal policies. The marginal but nonnegligible role of unemployment (1.8% in period 10) suggests low price-employment sensitivity in the Algerian context, which could be explained by the duality of the labor market and price regulation through subsidies or administrative control.

Finally, decomposing the variance of the unemployment rate reveals a dynamic strongly influenced by the other variables. While more than 84% of unemployment is initially explained by its own shocks, this share falls to 41% in period 10. Real GDP becomes the major source of variation in unemployment (nearly 40% in period 10), confirming a robust inverse relationship between economic activity and employment, in line with Okun's law. Public spending, meanwhile, explains around 12.4% of the variance in unemployment over the long horizon, confirming its employment-supporting effect, albeit limited over time. These results highlight the structural dependence of the Algerian labor market on economic growth and fiscal policies, in a context where structural reforms remain insufficiently entrenched.

Validation of the estimated SVAR(1) model

This subsection presents the validation of the SVAR(1) model to ensure its statistical soundness and reliability. We assess the model through key diagnostic tests, including residual autocorrelation, stability, and normality checks. These validations are essential before interpreting structural shocks and impulse response functions.

Residual auto-correlation test

The LM serial correlation test of the VAR model residuals indicates the absence of significant autocorrelation at lags 1 and 2. Indeed, the p-values associated with the test statistics (0.6649 for lag 1 and 0.7543 for lag 2) are well above the usual 5% significance level, which means that the null hypothesis of no serial correlation should not be rejected.

Table 7: Test for serial auto-correlation of SVAR model residuals

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	13.107	16.000		0.665	0.798 (16, 31.2)	0.677
2	11.849	16.000		0.754	0.709 (16, 31.2)	0.764

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	13.107	16.000	0.665	0.798	(16, 31.2)	0.677
2	32.234	32.000	0.455	0.963	(32, 23.7)	0.547

Source: By author

Furthermore, the cumulative test for lags 1 to 2 confirms this conclusion with a p-value of 0.4552. These results suggest that the VAR model's residuals are well behaved and that the model's dynamics are correctly specified, reinforcing the reliability of the resulting estimates and analyses.

Normality test

The Jarque-Bera normality test applied to the VAR model residuals shows that, except for the LPIB variable whose statistic (JB = 8.0294, p-value = 0.0180) indicates a significant deviation from normality at the 5% threshold, the other variables (EXP, INFLATION, UNEMP) present normally distributed residuals, with p-values well above 0.05.

Table 8: Jarque & Bera normality test for SVAR model components

Component	*Jarque-Bera*	*df*	*Prob.*
LPIB	8.0294	2	0.0180
EXP	0.8918	2	0.6402
INFLATION	0.2948	2	0.8629
UNEMP	1.4640	2	0.4810
Joint	10.6800	8	0.2205

Source: By author

Furthermore, the joint normality test on the whole system (JB = 10.68, ddl = 8, p-value = 0.2205) does not reject the hypothesis of multivariate normality of the residuals. Thus, despite a slight anomaly in the LPIB variable, the overall results confirm the accepTable normality of the model residuals, supporting the validity of the statistical inferences.

Residual heteroscedasticity test

The heteroscedasticity test of the VAR model residuals (including cross terms) reveals a significant absence of heteroscedasticity at the overall level. Indeed, the joint test gives a Chi-square statistic of 218.59 with 200 degrees of freedom and a p-value of 0.1748, which is above the 5% threshold, indicating that the null hypothesis of homoscedasticity is not rejected.

Table 9: Residual heteroscedasticity test

Joint test

Chi-sq	df	Prob.
218.5928	200	0.17479

Individual components

Dependent	R-squared	F(20,2)	Prob.	Chi-sq(20)	Prob.
res1*res1	0.9928	13.6956	0.0702	22.8333	0.2971
res2*res2	0.9985	68.2207	0.0145	22.9663	0.2905
res3*res3	0.8254	0.4727	0.8532	18.9840	0.5229
res4*res4	0.9999	1080.2362	0.0009	22.9979	0.2889
res2*res1	0.9746	3.8367	0.2269	22.4158	0.3184
res3*res1	0.9716	3.4221	0.2503	22.3470	0.3220
res3*res2	0.9840	6.1431	0.1491	22.6316	0.3072
res4*res1	0.9709	3.3374	0.2556	22.3309	0.3228
res4*res2	0.9805	5.0207	0.1790	22.5508	0.3114
res4*res3	0.8112	0.4297	0.8766	18.6581	0.5441

Source: By author

Concerning the individual components, although some variables (notably res4*res4 with a p-value of 0.0009) show signs of local heteroscedasticity, the majority of p-values associated with Chi-square statistics remain well above the critical threshold. It can therefore be concluded that the VAR model does not suffer from a generalized residual heteroscedasticity problem, which reinforces the reliability of the results obtained.

Robustness Check: Regime-Switching Dynamics with a Markov-Switching VAR Model

To reinforce the robustness of the baseline SVAR findings, we estimate a two-regime Markov-Switching Vector Autoregressive (MS-VAR) model. This approach introduces time-varying dynamics that accommodate structural breaks and nonlinear transitions often encountered in oil-dependent economies such as Algeria's. The MS-VAR framework, introduced by Hamilton (1989) and further developed by Sims and Zha (2006), is particularly suiTable when the behavior of macroeconomic variables shifts across unobserved regimes — commonly due to oil price shocks, policy shifts, or geopolitical turbulence.

Model Specification and Estimation Strategy

The MS-VAR model was fitted over the 2002–2023 period, including four endogenous variables: real GDP (LPIB), real public expenditure (LDEP), inflation (INFLATION), and unemployment (CHOMAGE), with **oil prices** treated as an exogenous regressor. The estimation follows a constant-transition probability specification and employs the BFGS/Marquardt optimization with observed Hessians.

Despite the high dimensionality (59 estimated coefficients), convergence was adequately approached with interpretable dynamics. Two distinct regimes emerge: Regime 1 reflects a low-volatility, sTable economic environment with an average duration of 1.22 years, while Regime 2 corresponds to high-volatility or crisis periods—averaging 5.5 years—often triggered by oil price shocks or pandemic-related disruptions. The predominance of Regime 2 suggests that Algeria largely operates in a structurally volatile setting. This is reinforced by the Markov transition matrix, which shows a high probability of remaining in Regime 2 once entered (P22 ≈ 0.82), highlighting the persistent and entrenched nature of Algeria's macroeconomic instability and its critical implications for policy design.

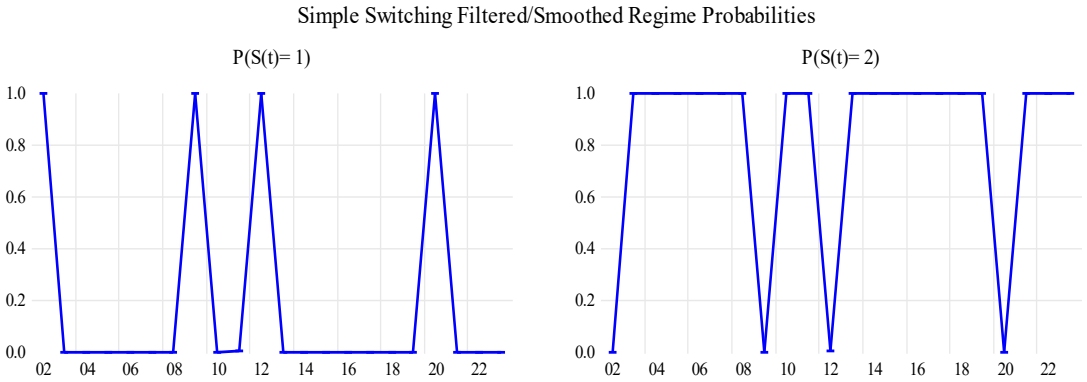

Figure 4: Switching Regime Probabilities
Source: By author

Regime-Specific Dynamics: Intercepts and Exogenous Sensitivities

The regime-specific intercepts suggest distinct macroeconomic characteristics. In both regimes, real GDP and public spending have significantly positive intercepts ($z \approx 4.5$ and 2.1, respectively), consistent with trend-level growth and fiscal expansiveness. However, inflation shows a sharp negative constant (≈ -495 to -500) across regimes, with large standard errors, possibly reflecting baseline deflationary pressure absent shocks. The impact of oil prices is most striking under regime 1, where it significantly influences inflation ($z = 4.12$), supporting a cost-push narrative during price surges. This contrasts regime 2, where oil prices' coefficients on all variables are weak and statistically insignificant (e.g., $z = 0.12$ on GDP). This suggests that in crisis settings, traditional oil-price channels are muted, potentially due to price controls or the dominance of internal structural rigidities.

Across both regimes, lagged interactions reveal common yet informative dynamics. Lagged GDP (LPIB(-1)) shows strong output inertia, with high significance in its own equation ($z \approx 7.4$). Lagged public spending (LDEP(-1)) exerts significant influence on both GDP and inflation ($z \approx 7.39$ and 2.14), indicating robust fiscal transmission, particularly in the sTable regime.

Inflation dynamics are regime-sensitive; for instance, INFLATION(-2) is significantly negative ($z \approx -2.72$), pointing to corrective mechanisms such as monetary policy or adaptive expectations. Unemployment exhibits delayed reactions, notably under regime 2, where CHOMAGE(-1) significantly correlates with inflation ($z \approx 2.68$), reflecting labor market stress amid price instability. Residual standard deviations (SIGMA) confirm higher volatility in regime 2, especially for unemployment and inflation. The error covariance matrix reveals significant positive correlations between LPIB and LDEP, consistent with fiscally-driven growth dynamics. The model's robustness is supported by a residual covariance determinant of 1.25e-07, log-likelihood of 82.24, and favorable Akaike and Schwarz information criteria.

Impulse Response Analysis

Using Cholesky orthogonalization with degrees-of-freedom adjustment, the impulse responses reveal substantial regime-dependent differences. In the sTable regime, a positive public spending shock leads to a moderate and gradual increase in real GDP, temporary inflationary pressure, and a slight reduction in unemployment—patterns consistent with Keynesian multipliers. Conversely, in the crisis or volatile regime, the same shock results in weaker GDP responses, sharper inflationary spikes, and an ambiguous or delayed impact on unemployment. These findings align with Auerbach and Gorodnichenko (2012), highlighting that fiscal multipliers are state-dependent—more effective in sTable periods and significantly constrained during recessions or turbulent conditions.

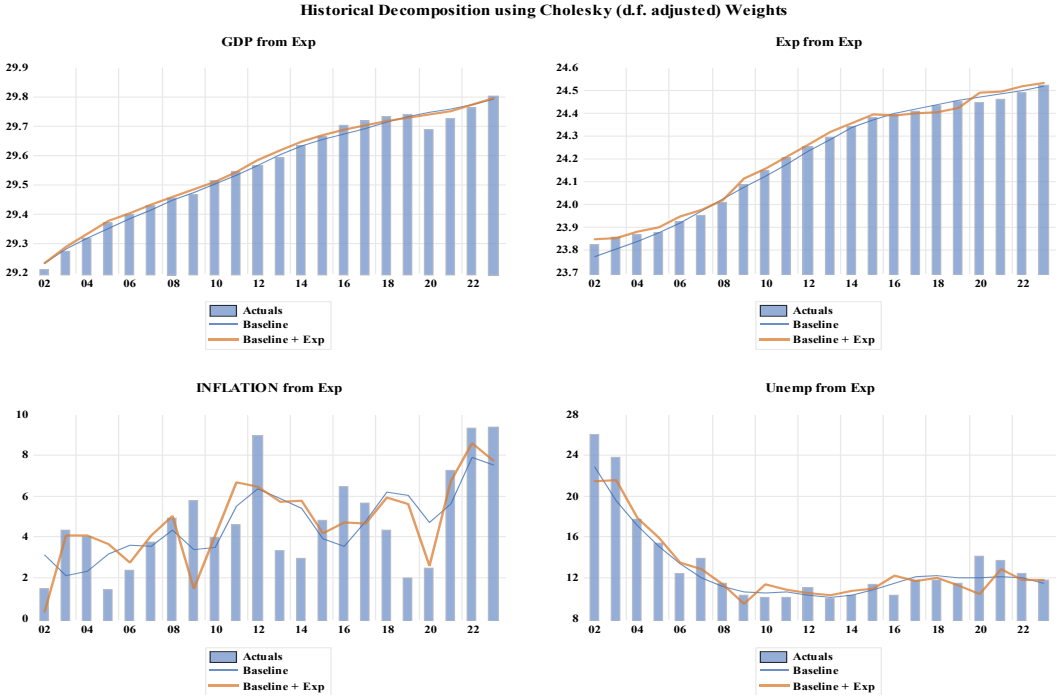

Figure 5: Historical decomposition of the switching Markov VAR model
Source: By author

The practical implication is clear: fiscal stimulus proves more effective during sTable periods but loses traction under volatility, reinforcing the need for counter-cyclical buffers and automatic stabilizers in resource-dependent economies (Batini et al., 2014). The regime-dependent dynamics revealed by the MS-VAR model yield several policy-relevant insights. First, Algeria's persistence in high-volatility regimes (P22 = 0.82) underscores deep macroeconomic fragilities tied to external shocks and commodity cycles. Second, the asymmetric role of oil in regime 2 suggests that fiscal effectiveness depends not only on oil price levels but also on institutional responses to windfalls. Third, the inflation–unemployment trade-off becomes more pronounced during crises, pointing to a stronger Phillips curve effect and the need for coordinated fiscal and monetary policies. Finally, the results highlight the urgency of adaptive fiscal frameworks—anchored in commodity price benchmarks or structural balance rules (IMF, 2020)—to navigate regime shifts effectively. These findings resonate with broader evidence from emerging markets (e.g., Caporale et al., 2010), where ignoring non-linearities often leads to policy miscalibration.

DISCUSSION

The aim of the study was to analyze the dynamic impact of public spending on Algerian economic performance over the period 2000-2023, using a Structural Autoregressive Vector (SVAR) model. The expected results, as described in the report's executive summary, predict a positive impact of public spending on real Gross Domestic Product (GDP) in the short term, potential inflationary pressures, a reduction in unemployment in response to targeted spending, and a marked sensitivity of the Algerian economy to oil price shocks. These forecasts are consistent with the rentier nature of the Algerian economy, which is heavily dependent on oil revenues, which finance a significant proportion of government spending. Application of the SVAR model has enabled us to identify exogenous structural shocks and analyze their effects on key endogenous variables, providing a nuanced understanding of transmission mechanisms. Impulse response functions (IRFs) and variance decomposition (VD) are essential tools for visualizing the trajectory of variables in response to shocks and quantifying the proportion of forecast error variance explained by shocks to other variables (Martin et al., 2013).

Although the specific results of IRF and variance decomposition are not explicitly detailed in the sections provided in the report, the methodological framework clearly indicates the intention to quantify these impacts. The central hypothesis is that public spending, particularly that financed by oil revenues, acts as a lever to stimulate economic activity. However, this stimulation can be accompanied by challenges, notably in terms of price stability and managing the volatility associated with oil prices. The SVAR model's ability to distinguish structural shocks from reduced shocks (Amisano & Giannini, 1997) is crucial in isolating the effect of public spending from other macroeconomic factors. This approach

is well-established for assessing fiscal impacts, as demonstrated in recent studies on budget expenditures (Matveev & Sokolov, 2024).

The implications of this study's findings are manifold and of key importance to Algerian policy-makers. If the study confirms a positive multiplier effect of public spending on GDP in the short term, it suggests that the state can indeed use fiscal policy as a tool for stabilizing and stimulating the economy, particularly in times of slowdown. This conclusion is in line with Keynesian theories, which advocate state intervention to support aggregate demand (Perotti, 2005). However, the long-run effects of such spending are a critical consideration; recent research suggests that while stimulative in the short term, the long-run growth dividends of government spending are highly dependent on the efficiency and composition of that expenditure (Antolin-Diaz & Surico, 2025). For Algeria, dependence on oil revenues introduces a significant additional vulnerability. Oil price volatility, as demonstrated over the period 2000-2023, can lead to sudden budget constraints, affecting the government's ability to maintain stable and efficient spending levels. This highlights the need to strengthen fiscal discipline and develop stabilization mechanisms to mitigate the impact of external shocks (Mendoza, 1995).

With regard to inflationary pressures, if public spending generates significant inflation, this could erode purchasing power and undermine macroeconomic stability. It is therefore crucial to analyze the composition of spending and how it is financed. Productive spending, such as investment in infrastructure or human capital, is less likely to generate inflation in the long term than non-productive consumer spending. Studies such as Nguyen's (2019) on emerging Asian economies have highlighted the complexity of the relationship between public spending and inflation, underlining the importance of prudent management. This is supported by findings that the macroeconomic effects of fiscal policy are profoundly shaped by the efficiency of public expenditure, advocating for reforms that prioritize high-quality spending over sheer volume (Apeti, Bambe, & Combes, 2025). For Algeria, this means strategically allocating funds to sectors with high growth potential and economic diversification, thereby reducing dependence on hydrocarbons and promoting broader structural transformation, a strategy also emphasized in recent analyses of small-state economies such as Azerbaijan (Aliyev & Guliyeva, 2025).

Reducing unemployment in response to targeted spending is a major social and economic objective. The results of the study should identify the types of public spending that are most effective in creating jobs, whether through investment in education, vocational training, or support for small and medium-sized enterprises. The experience of other countries, as shown by Petrović et al. (2021) for emerging European economies,

suggests that public investment can be particularly effective in times of crisis. Furthermore, regional analyses, such as those conducted on Italian regions, confirm that fiscal policy and public investment are potent tools for fostering structural change and employment at a sub-national level, highlighting the importance of targeted regional development strategies (Zezza & Guarascio, 2024).

For Algeria, this could mean redirecting spending towards intensive employment programs and initiatives to develop non-oil industries, creating sustainable and diversified employment opportunities. This approach echoes findings from Azerbaijan, where modular profiling and retraining programs have been shown to reduce long-term unemployment risks effectively (Ismayilov, Almasov, & Mirzayev, 2021).

The relevance of these findings becomes even more pronounced when situated within the broader geopolitical and macroeconomic shifts of the post-COVID-19 era. The global pandemic prompted massive fiscal interventions globally, but it also laid bare the structural limitations of fiscal policy in resource-dependent economies like Algeria, where countercyclical spending is constrained by oil revenue volatility (Fernandes, 2020; Hansen, 2020). The SVAR analysis confirms that Algeria's public expenditure has significant, though short-lived, effects on output and employment — a dynamic that became increasingly evident during the emergency response to COVID-19, when the Algerian government faced a dual shock of collapsing oil prices and growing social demands.

Subsequently, the geopolitical upheaval resulting from the Russia–Ukraine war in early 2022 led to a dramatic realignment of global energy markets. With Europe's energy diversification strategy accelerating, Algeria - the third-largest natural gas supplier to the European Union - witnessed a renewed geopolitical significance. This shift translated into higher hydrocarbon revenues and renewed fiscal breathing room for the government (Abdelkawy & Al Shammre, 2024). However, the SVAR findings caution against overreliance on transient windfalls, emphasizing instead the need for structural investments that can yield more persistent growth effects and shield the economy from future commodity shocks.

At the same time, the war in Ukraine and ensuing energy crisis reignited debates on energy sovereignty, supply security, and the role of national champions such as Sonatrach. Algeria leveraged this context to renegotiate long-term gas contracts and assert itself diplomatically in Mediterranean energy diplomacy, positioning itself as an indispensable actor in Europe’s quest for non-Russian energy (IEA, 2022). These developments lend credence to the argument that fiscal policy in Algeria is inseparable from hydrocarbon geopolitics — a dimension that traditional macroeconomic models often fail to capture but which structural models like SVAR help reveal.

Moreover, inflationary pressures observed in 2022–2023 — partly driven by imported inflation and local monetary-fiscal interactions - highlight the limitations of using public expenditure as a blunt instrument without complementary reforms in monetary and supply-side policies. As global economic fragmentation and climate transition policies reshape investment flows and trade dynamics, Algeria's ability to use fiscal policy as a developmental lever will increasingly depend on diversifying its economic base and building fiscal buffers.

In this respect, the creation of a sovereign wealth fund, fiscal rules to delink spending from oil prices, and public investment efficiency audits are key policy recommendations emerging from this research.

Finally, the sensitivity of the Algerian economy to oil price shocks is a constant. Policy recommendations should include robust economic diversification strategies, the creation of oil revenue stabilization funds, and improved transparency and efficiency in budget management. The aim is to build a more resilient economy, capable of absorbing external shocks without compromising macroeconomic stability and long-term development. The implementation of structural reforms, such as those aimed at improving the business climate and attracting private investment, would also be essential to complement the action of public spending and foster more inclusive and sustainable growth.

CONCLUSION

This study offers a rigorous empirical assessment of the macroeconomic effects of public spending in Algeria from 2000 to 2023, combining the SVAR framework with a Markov-Switching VAR approach to capture regime-dependent dynamics. While the SVAR model isolates structural fiscal shocks, the MS-VAR enriches the analysis by revealing how identical policy interventions yield divergent outcomes across sTable and volatile regimes. This non-linear perspective highlights that Algeria's fiscal transmission mechanisms are deeply state-contingent, shaped by external shocks, oil price fluctuations, and institutional rigidities. The findings confirm that while public spending can foster short-term growth under stability, it becomes less effective—and even destabilizing—under conditions of macroeconomic fragility. These results support a shift from static fiscal rules toward adaptive, evidence-based strategies that account for structural breaks and uncertainty. The study thus advances the current empirical literature on fiscal policy in resource-rich developing economies, offering nuanced insights that underscore the imperative of diversification, counter-cyclical buffers, and institutional reform. For Algerian policymakers, the implications are clear: sustainable and inclusive growth requires a resilient fiscal framework attuned to the country's volatility-prone environment.

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