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DO POSITIVE AND NEGATIVE MACROECONOMIC SHOCKS AFFECT ECONOMIC GROWTH DIFFERENTLY? EVIDENCE FROM IRAQ USING THE NARDL MODEL

Ghada abdulmasih Hanna, PhD
Technical Institute of Administration – Nineveh Northern Technical University, Iraq
chadadawood@ntu.edu.iq

Abstract

This study investigates the asymmetric relationship between key macroeconomic variables and economic growth in Iraq by employing the Nonlinear Autoregressive Distributed Lag (NARDL) model. While traditional research has often assumed symmetric effects of macroeconomic shocks, this paper addresses the research gap by exploring whether positive and negative changes in energy use, foreign direct investment, gross capital formation, inflation, and trade exert different impacts on per capita GDP growth. Annual data for the period 1985–2025 were collected from the World Bank and subjected to stationarity and integration tests before applying the NARDL framework. The findings reveal that Iraq's economic growth responds asymmetrically to both short- and long-term macroeconomic shocks. Energy use and trade openness show significant positive long-run effects, while declines in trade and energy shocks have weaker but notable negative consequences. Foreign direct investment demonstrates a paradoxical negative effect on growth, reflecting institutional and political constraints that limit its productive absorption. Public investment exerts mixed asymmetric effects depending on timing, while inflation shows dual impacts, with moderate increases stimulating growth but negative shocks undermining stability. In the short run, the economy displays rapid adjustment dynamics, highlighting its vulnerability to external and internal shocks. Overall, the study underscores the necessity of non-linear modeling to capture Iraq's structural complexities and provides critical insights for policymakers to design flexible fiscal, monetary and trade policies that mitigate adverse shocks and support sustainable, diversified growth.

Keywords: Economic Growth – Asymmetric Effects - Macroeconomic Variables Nonlinear Model – NARDL – Asymmetric Effects

INTRODUCTION

Economic growth represents a fundamental indicator for evaluating the overall performance of national economies and serves as a cornerstone in formulating policies aimed at achieving financial stability and social welfare (Barro, 1991; Aghion & Howitt, 2009). The study of growth determinants has, for decades, been closely linked to the development of econometric models, with the literature examining the roles of investment, inflation, trade openness, energy consumption, and foreign capital inflows in explaining variations in gross domestic product (GDP). However, most traditional studies have assumed a linear relationship, positing that the effects of these variables on growth are symmetric—that is, positive and negative shocks operate through identical but opposite mechanisms (Pesaran & Shin, 1999). Empirical evidence, particularly in developing and resource-dependent economies, has challenged this assumption, demonstrating that economic responses are often asymmetric, depending on the direction and magnitude of shocks (Kilian & Vigfusson, 2011). In this context, the Nonlinear Autoregressive Distributed Lag (NARDL) model developed by Shin et al. (2014) has emerged as an advanced standard tool, enabling the differentiation between positive and negative shocks over both short- and long-run horizons. This model is distinguished by its capacity to handle time series of mixed integration orders, I(0) and I(1), while providing dynamic analysis of economic shocks, thereby offering a deeper understanding of complex interrelationships among variables compared to linear models**.**

The relevance of this approach becomes particularly evident when examining the Iraqi economy. Since 2003, Iraq has relied almost entirely on oil revenues as the main source of GDP and public revenues, rendering economic growth highly susceptible to global oil price fluctuations (IMF, 2021). This dependence has manifested in expansionary booms during periods of rising prices and contractionary crises when prices fall, as observed during the global financial crisis (2009), the oil price crisis (2014–2016), and the COVID-19 pandemic (2020). In addition, the Iraqi economy continues to face persistent structural challenges, including limited diversification, exchange rate volatility, high unemployment, and inflationary pressures (World Bank, 2022). These factors render economic responses to shocks asymmetric and more complex compared to stable and diversified economies.

This context gives rise to fundamental research questions: Do increases in foreign direct investment (FDI) contribute to growth to the same extent that decreases hinder it? Does trade openness stimulate economic growth with the same efficiency that its decline impedes it? What is the nature of the effects of inflation or energy consumption in a resource-dependent and fragile economy such as Iraq? Addressing these questions necessitates the use of a model

capable of capturing differential effects, which justifies the adoption of the NARDL framework in this study.

Research Gap

Despite the abundance of studies examining the impact of economic policies on growth, most have relied on linear and symmetric assumptions, overlooking the differential effects of positive and negative shocks. Research applying the NARDL model has often focused on limited domains, such as exchange rates or oil prices (Bahmani-Oskooee & Fariditavana, 2015), without integrating the three main economic policy channels—fiscal, monetary, and trade—within a unified framework. In the Iraqi context, studies have largely been confined to analyzing oil revenues or fiscal policy, neglecting monetary and trade dimensions, as well as the asymmetric nature of economic relationships (Al-Mawlawi, 2020). This knowledge gap underscores the need for a comprehensive investigation employing the NARDL model to examine the asymmetric relationships between economic policies and economic performance, with Iraq serving as a salient case study of a resource-dependent rentier economy**.**

Research Objectives

This study aims to achieve the following objectives:

- To estimate the asymmetric effects of economic policies—fiscal, monetary, and trade—on economic growth using the NARDL model, distinguishing between positive and negative shocks.
- To integrate the three policy channels within a unified analytical framework that captures their interactions and combined impact on economic performance.
- To analyze both the short- and long-term effects of economic policies, thereby identifying dynamic trends influencing growth.
- To provide a case study of the Iraqi economy that can serve as a reference for future comparative analyses with other economies exhibiting similar income levels or structural characteristics.

Research Contributions

This study makes original contributions to the macroeconomic literature in the context of resource-dependent economies as follows:

- Methodological Innovation: It employs the Nonlinear Autoregressive Distributed Lag (NARDL) model to measure the asymmetric effects of economic shocks, surpassing the limitations of traditional linear models.

- Analytical Integration: It combines fiscal, monetary, and trade policies within a single temporal framework (1985–2025) to assess their interactions with economic growth.
- Addressing Contextual Gaps: It provides the first long-term assessment of Iraq, testing positive and negative growth responses to key variables such as foreign direct investment, energy consumption, and trade openness.
- Policy-Relevant Findings: It demonstrates that energy consumption and trade openness enhance long-term growth, while the negative effects of foreign investment reflect institutional constraints, and inflation and capital expenditures exhibit nonlinear relationships.
- Generalizability: The analytical framework allows the application of findings to similar oil-dependent economies, thereby enhancing the value of international comparisons.

LITERATURE REVIEW

Recent economic literature increasingly employs the NARDL model to examine the asymmetric effects of aggregate variables on economic growth, capturing differential impacts of positive and negative shocks in both the short and long run. For instance, Jiang and Wang (2023) analyzed human health capital in China, finding that reductions in government and private health expenditures negatively affect growth more than equivalent increases. Similarly, Abdelli et al. (2024) assessed Tunisian government spending in agriculture, health, education, and defense, reporting that increases in agriculture and health spending promote growth, while decreases hinder it, and that education and defense expenditures exhibit context-dependent negative effects, reflecting nonlinear fiscal-growth dynamics. Mosikari (2020) highlighted that in Namibia, export declines are more detrimental than equivalent gains, emphasizing the importance of trade policies sensitive to export volatility.

In the Saudi context, Kumar et al. (2025) linked renewable energy consumption and economic complexity to growth, showing that negative shocks in both dimensions have stronger adverse effects than positive shocks. Mighri and AlSaggaf (2023) confirmed these asymmetric patterns using NARDL and MT-NARDL models, finding that long-term negative shocks in renewable energy reduce growth, while short-term effects can be positive; economic complexity is mainly affected by negative long-term shocks, and extreme variations in energy consumption exert distinct effects compared to smaller fluctuations. These findings provide nuanced insights for designing short- and long-term economic policies.

Focusing on Iraq, Ahmed (2025) employed a Bootstrap NARDL approach to examine money supply and public expenditure, revealing asymmetric responses: increases in money supply rapidly boost public spending, whereas decreases generate varying negative effects in

magnitude and duration. This asymmetry is particularly pronounced in Iraq due to its reliance on oil revenues and exposure to external shocks.

Overall, these studies consistently indicate that aggregate-growth relationships are nonlinear and asymmetric. The NARDL framework effectively captures these dynamics, demonstrating that negative shocks often outweigh positive ones, thereby offering a robust basis for policy formulation in economies subject to sharp fluctuations, such as Iraq.

ECONOMIC GROWTH IN IRAQ: AN ANALYTICAL OVERVIEW

Gross Domestic Product (GDP) and GDP per capita are central indicators of Iraq's economic performance and long-term trajectory. Since 2003, the Iraqi economy has experienced pronounced fluctuations driven by oil price volatility and internal and external crises. High crude oil prices between 2004 and 2008 fueled strong growth, whereas the global financial crisis in 2009 and the subsequent oil price decline during 2014–2016 caused GDP contractions. A similar downturn occurred during the COVID-19 pandemic in 2020, when GDP fell by approximately 22% due to reduced global demand and disrupted supply chains (Ministry of Planning, 2022). GDP per capita demonstrates marked vulnerability, reflecting its heavy dependence on the oil sector. Data from the World Bank and IMF indicate a rise to around USD 6,400 in 2022, driven by the oil boom, followed by a 14% decline in 2023, highlighting the limited developmental impact of nominal revenue gains (World Bank, 2024; IMF, 2024). Even PPP-adjusted estimates, at USD 12,700 in 2024, are constrained by inflation, exchange rate volatility, and high unemployment, limiting improvements in real living standards.

These patterns confirm that Iraq's growth remains highly sensitive to oil shocks, consistent with resource-dependence literature (Auty, 2001; Elbadawi & Makdisi, 2017). The absence of economic diversification further reinforces structural challenges to sustainable per capita growth. Accordingly, assessing the role of oil revenues and macroeconomic policies in shaping growth requires advanced econometric approaches, such as the NARDL model, to capture the asymmetric effects of external shocks on Iraq's economic trajectory.

METHODOLOGY

The empirical aspect of this study relies on annual data covering the period 1985–2025, obtained from the World Development Indicators (WDI) database published by the World Bank (World Bank, 2025). The World Bank applies strict standards in data collection, verification, and quality control, and clearly documents any potential limitations or gaps in the data. The time series used in this study is complete, with no missing values throughout the sample period.

The extended period (1985–2025) allows for the analysis of long-term relationships between variables, encompassing significant structural changes at both the national and global levels, including external shocks and economic reforms. However, the reliance on annual data may not capture some short-term economic cycles. While sufficient for the current analysis, future research could employ higher-frequency data (quarterly or monthly) to examine more granular dynamics.

The dependent variable in this study is GDP per capita growth, widely used in the literature as a measure of economic growth. The main independent variables include:

- Energy Use: Measured in kilograms of oil equivalent per capita.
- Foreign Direct Investment (FDI): Represented as a percentage of GDP.
- Gross Capital Formation: Measured as a percentage of GDP.
- Inflation: Expressed as the relative change in the consumer price index (%).
- Trade Openness: Measured as the sum of exports and imports relative to GDP.

These variables were selected based on standard growth models and previous empirical studies, reflecting the key determinants influencing the trajectory of economic growth.

The empirical component of this study is based on the Nonlinear Autoregressive Distributed Lag (NARDL) model, owing to its capacity to measure the asymmetric effects of independent variables on the dependent variable. To prepare the data for estimation, the time series of the independent variables were decomposed into two components representing positive and negative changes, allowing the dependent variable's responses to positive and negative shocks to be tracked separately. This procedure enables testing whether the relationships between variables are symmetric or asymmetric, providing a more realistic depiction of economic dynamics and enhancing the accuracy of the results (Shin, 2014: 283). Symmetry testing in the NARDL framework serves as a methodological tool to examine whether the short- and long-term effects of the independent variables are equal or differ. Symmetry implies that positive and negative changes in the independent variables produce effects of equal magnitude but opposite direction on the dependent variable. Asymmetry, on the other hand, indicates that the magnitude and impact of these changes may differ, either in size or direction. The model employs the Cumulative Dynamic Multiplier (CDM), which allows researchers to measure the total effect of any change in an explanatory variable on the dependent variable over time. The multiplier can take positive or negative values depending on the direction of the change and is capable of capturing asymmetric differences between positive and negative variations, reflecting the extent to which their effects diverge. For instance, if a positive change in an independent variable exerts a greater impact on the dependent variable than a negative

change of the same magnitude, the CDM will reflect this difference by displaying a higher value for positive changes (Al Khatib & Kanaan, 2023: 7).

Building on the above, the NARDL model allows for representing the relationship between the dependent variable and the independent variables while separating the positive and negative effects of each variable and accounting for differences between the short- and long-term horizons. This representation enables the researcher to assess the degree of asymmetry in GDP responses to changes in key economic variables, providing a precise and comprehensive estimate of the relative impact of each variable. Accordingly, the typical equation capturing these complex economic relationships can be formulated as follows:

$$\begin{aligned}\Delta GDP_t = {} & \propto_0 + \propto_1 GDP_{t-1} + \propto_2 ENERGY_t^+ + \propto_3 ENERGY_{t-1}^- + \propto_4 FDI_{t-1}^- + \propto_5 FDI_t^+ + \propto_6 GCF_{t-1}^- \\ & + \propto_7 GCF_{t-1}^+ + \propto_8 INFLATION_{t-1}^- + \propto_9 INFLATION_{t-1}^+ + \propto_{10} TRADE_{t-1}^- \\ & + \propto_{11} TRADE_{t-1}^+ + \beta_1 \Delta GDP_{t-1} + \beta_2 \Delta ENERGY_t^- + \beta_3 \Delta ENERGY_{t-1}^- + \beta_4 \Delta FDI_t^- \\ & + \beta_5 \Delta GCF_t^- + \beta_6 \Delta GCF_t^+ + \beta_7 \Delta GCF_{t-1}^+ + \beta_8 \Delta INFLATION_t^- + \beta_9 \Delta INFLATION_{t-1}^- \\ & + \beta_{10} \Delta INFLATION_t^+ + \beta_{11} \Delta TRADE_t^- + \beta_{12} \Delta TRADE_t^+ + \varepsilon_t\end{aligned}$$

The above equation represents the NARDL model, linking economic growth to a set of key economic variables while accounting for asymmetric effects. The coefficient $\propto_0$ denotes the constant term, whereas $\propto_1 GDP_{t-1}$captures the effect of past accumulated economic growth on current growth, illustrating the inherent dynamics of the economic system. The independent variables are decomposed into positive and negative components (+/-) for each of Energy Use (ENERGY), Foreign Direct Investment (FDI), Gross Capital Formation (GCF), Inflation (INFLATION), and Trade (TRADE). The coefficients $\propto_2$ to $\propto_{11}$ represent the long-term effects of these variables on growth, while the coefficients β_1 to β_{12} reflect the short-term impacts of contemporaneous changes (Δ) in the independent variables on the dependent variable, with positive and negative changes treated separately. Finally, ε_t denotes the stochastic error term, capturing unobserved factors and random components within the economic system.

ANALYSIS AND RESULTS

Prior to applying the ARDL/NARDL model to per capita GDP and the main economic variables in Iraq, the stability and time series integration properties of these variables were first examined using unit root tests, with particular emphasis on the Phillips–Perron (PP) test. The Phillips–Perron test is an advanced statistical tool designed to assess the presence of a unit root in time series data. It is particularly suitable for handling heteroskedasticity and serial correlation in the error terms, making it more appropriate than some traditional tests, such as the Augmented Dickey-Fuller test, especially when analyzing complex economic data

(Levendis, 2018:156). The test was conducted for each variable at the level, including a deterministic trend where necessary, to determine the order of integration (I(0) or I(1)) of each variable. This procedure ensures the validity of employing the ARDL model and provides reliable short- and long-term results.

Table 1. Unit Root Test Results *(EViews 13 output)*

Variables	Without Trend	With Trend	Degree of Integration
GDP_PER_CAPITA_GROWTH	-9.979657 (0.0000)*	-11.64568 (0.0000)*	I(0**)**
D(ENERGY_USE)	-6.140891 (0.0000)*	-6.020157 (0.0001)*	I(1)
D(FOREIGN_DIRECT_INVESTMENT)	-8.086631 (0.0000)*	-7.998429 (0.0000)*	I(1)
GROSS_CAPITAL_FORMATION	-4.869023 (0.0000)*	-4.830448 (0.0019)*	I(0**)**
D(INFLATION)	-12.07726 (0.0000)*	-12.23465 (0.0000)*	I(1)
D(TRADE)	-5.462123 (0.0001)*	-5.397714 (0.0264)*	I(1)
*() p-value			

The following table presents the test results with their corresponding probability statistics, highlighting the order of integration for the key variables—economic growth, energy consumption, foreign direct investment, public capital expenditure, inflation, and external trade. This analysis provides a robust foundation for understanding the economic dynamics and their positive and negative effects on economic growth in Iraq.

Discussion of Results

First – Cointegration

Table 2. Bounds Test *(EViews 13 output)*

Test Statistic	Value					
F-statistic	**9.700417**					
	10%		5%		1%	
Sample Size	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
35	**2.254**	**3.388**	**2.685**	**3.960**	**3.713**	**5.326**
40	**2.218**	**3.314**	**2.618**	**3.863**	**3.505**	**5.121**
Asymptotic	**1.990**	**2.940**	**2.270**	**3.280**	**2.880**	**3.990**
*** Finite sample critical values are valid up to 7 error-correction variables.						

The Bounds Test results reject the null hypothesis of no long-run equilibrium relationship among the ten variables included in the model. The calculated F-statistic is 9.700, substantially exceeding the upper critical bound at the 1% significance level, thereby providing strong evidence of a stable long-run cointegrating relationship. Despite the relatively small sample size of 38 observations, the findings remain robust and reliable. This indicates that any deviations from the long-run equilibrium path are gradually corrected over time, reflecting a genuine structural relationship among the variables rather than transitory short-run fluctuations. Accordingly, the existence of cointegration supports the appropriateness of employing the ARDL or NARDL framework, whereby the long-run specification captures the underlying structural relationships, while the short-run dynamics explain the adjustment process and transitional fluctuations.

Second – Long-Term Results

Table 3. Long-Term Effects of the Variables *(EViews 13 output)*

Variables	Coefficient	t-Statistic	Prob.
ENERGY_POS	0.080520	6.703240	0.0000
ENERGY_NEG(-1)	0.098955	2.946499	0.0106
FDI_POS	-11.78318	-4.540626	0.0005
FDI_NEG(-1)	-3.321442	-4.187684	0.0009
GCF_POS(-1)	-1.712815	-3.581653	0.0030
GCF_NEG(-1)	-1.299644	-4.585177	0.0004
INFLATION_POS(-1)	0.306389	4.179501	0.0009
INFLATION_NEG(-1)	0.273588	3.617486	0.0028
TRADE_POS(-1)	1.040020	2.878176	0.0122
TRADE_NEG(-1)	-0.116330	-0.913163	0.3766
Constant (C)	-37.13352	-5.823668	0.0000

Table 3 demonstrates that Iraq's per-capita GDP growth is shaped by several structural determinants that serve as core drivers of sustainable expansion. The energy sector exerts a clearly positive influence, as indicated by the coefficients of ENERGY_POS and ENERGY_NEG(-1). This underscores the pivotal role of oil production in providing government revenue and liquidity. Sustained increases in energy output or improved resource management directly strengthen long-run growth, whereas past negative energy shocks dampen it, though with less intensity than the positive effects. Foreign direct investment (FDI) shows a significant negative impact through both FDI_POS and FDI_NEG(-1), reflecting Iraq's limited capacity to absorb external capital and convert it into long-term productive projects. Persistent political risks and security concerns further constrain the growth potential of foreign inflows. Public capital

expenditure, captured by GCF_POS(-1) and GCF_NEG(-1), remains an important catalyst of economic activity. Government investment—whether during expansionary or contractionary phases—supports infrastructure improvements and stimulates productive sectors. However, the differing signs of these coefficients highlight the need for more coherent and sustainable investment policies to mitigate structural volatility. Regarding inflation, the results reveal a dual effect. The positive and significant coefficient of INFLATION_POS(-1) points to the role of liquidity and moderate price increases in stimulating economic activity. Meanwhile, the weaker positive effect of INFLATION_NEG(-1) indicates that the economy can withstand limited price declines without hindering growth, reflecting a delicate balance between inflation and macroeconomic stability. For external trade, the positive coefficient of TRADE_POS(-1) confirms that greater openness and export expansion foster long-term growth, whereas the modestly negative but statistically insignificant effect of TRADE_NEG(-1) suggests that trade contractions exert only a limited drag. This pattern underscores Iraq's heavy reliance on oil exports and the urgent need to diversify its export base to enhance economic resilience.

Taken together, these findings show that Iraq's long-run economic growth is primarily driven by the energy sector, public investment, and fiscal and trade policies, while foreign direct investment remains relatively ineffective. Achieving durable growth therefore requires an integrated strategy that aligns monetary and investment policies with robust economic-diversification plans, reducing oil dependence and strengthening the economy's capacity to absorb external shocks.

Third – Short-Term Results

Table 4. Short-Term Effects of the Variables with Error Correction Speed *(EViews 13 output)*

Variables	Coefficient	t-Statistic	Prob.
COINTEQ(-1)*	-1.600171	-28.22845	0.0000
D(GDP_PER_CAPITA_GROWTH(-1))	0.267874	7.770474	0.0000
D(ENERGY_NEG)	0.112961	15.28076	0.0000
D(ENERGY_NEG(-1))	-0.016813	-2.605622	0.0152
D(FDI_NEG)	-0.671801	-1.147013	0.2622
D(GCF_POS)	-0.058301	-1.020324	0.3173
D(GCF_POS(-1))	0.764098	8.026931	0.0000
D(GCF_NEG)	0.035328	0.447522	0.6584
D(INFLATION_POS)	0.214902	10.33974	0.0000
D(INFLATION_NEG)	-0.019581	-2.221665	0.0356
D(INFLATION_NEG(-1))	-0.178290	-7.432511	0.0000
D(TRADE_POS)	0.453668	5.088462	0.0000
D(TRADE_NEG)	-0.977851	-15.86926	0.0000

Source: Prepared by the author based on EViews 13

The results indicate that the Iraqi economy is highly sensitive to short-term fluctuations. The large and negative error correction term, COINTEQ(-1), suggests that any deviation from the long-term equilibrium is corrected rapidly, reflecting the economy's responsiveness to changes in energy, investment, public spending, and trade. This also demonstrates the economy's capacity to absorb economic shocks over a short period. The positive and significant coefficient of D(GDP_PER_CAPITA_GROWTH(-1)) indicates that previous growth partially supports current growth, highlighting the presence of short-term economic memory in Iraq, which is largely dependent on the structure of the economy, particularly its focus on key sectors such as oil. Energy exhibits a dual effect: the positive and significant coefficient of D(ENERGY_NEG) suggests that a sudden decline in energy production or prices stimulates short-term growth, whereas the negative impact of D(ENERGY_NEG(-1)) indicates that a previous energy shock tends to restrain growth after a short period. This underscores Iraq's heavy reliance on oil as a primary source of government revenue and liquidity. Foreign direct investment, D(FDI_NEG), appears insignificant, indicating that reductions in foreign inflows do not directly affect short-term growth. This reflects the limited benefits of FDI due to political risks and security instability. In contrast, public capital expenditure, D(GCF_POS(-1)), shows a positive and significant effect on current growth, while the immediate effect is insignificant, highlighting the importance of government projects in stimulating economic activity and the time lag associated with investment implementation. Inflation demonstrates a dual effect: positive inflation shocks, D(INFLATION_POS), enhance growth, indicating the role of liquidity in stimulating economic activity, while negative inflation shocks, D(INFLATION_NEG) and D(INFLATION_NEG(-1)), exert a significant negative effect, reflecting the economy's sensitivity to inflationary fluctuations and the role of monetary policy in either promoting or constraining growth. Regarding external trade, the results show that D(TRADE_POS) positively and significantly contributes to growth, whereas D(TRADE_NEG) strongly reduces it. This highlights Iraq's substantial reliance on oil exports, imports, and essential commodities, emphasizing the need for economic diversification and reduced direct dependence on oil.

Collectively, these findings suggest that the Iraqi economy exhibits high short-term adaptability to shocks, benefiting from public investment and external trade as major growth drivers, while foreign investment remains of limited influence. Fiscal and monetary policies play a crucial role in guiding growth, underscoring the need for sustainable strategies to manage resources and achieve long-term stability.

After analyzing both short- and long-term relationships between economic growth and key macroeconomic variables in Iraq, this study identifies the positive and negative effects of

each variable and examines their symmetry or asymmetry. The aim is to understand how increases and decreases in energy use, foreign direct investment, public capital expenditure, inflation, and external trade differently affect economic growth, thereby complementing the insights provided by the long- and short-term tables. The following table summarizes these findings, emphasizing coefficient magnitudes, statistical significance, and distinctions between positive and negative effects.

Table 5. Description of Symmetric and Asymmetric Relationships in the Model *(EViews 13 output)*

Independent Variable	Positive Effect (POS)	Negative Effect (NEG)	Description (Symmetric/Asymmetric)
Energy use	Positive and significant (0.0805)	Negative/positive depending on periods: some lags negative, others positive and significant	Asymmetric – the impact of increases differs from decreases
FDI	Strong negative and significant (-11.78)	Weak and insignificant in the short term, but negative and significant at lags	Asymmetric – inflows (FDI_pos) have a clear negative effect, while declines (FDI_neg) show a different impact
Gross capital formation	Insignificant immediately, but negative and significant at lags (-0.89, -0.76)	Strongly negative and significant at lags (-1.33)	Asymmetric – the effects of increases are not similar to those of decreases
Inflation	Positive and significant (0.21 and 0.30)	Weak or negative and significant in some periods (-0.178)	Asymmetric – positive inflation stimulates growth, whereas negative inflation suppresses it
Trade	Positive and significant at lags (0.586, 1.04)	Strong negative and significant (-0.97)	Asymmetric – the effect of positive trade openness differs from trade declines

All key macroeconomic variables in the Iraqi economy exhibit asymmetric effects, with the impacts of increases differing from those of decreases on per capita GDP growth. This highlights the high sensitivity of the Iraqi economy to changes in energy, foreign direct investment, public capital expenditure, inflation, and external trade. It underscores that economic policies should consider the nature of shocks—whether positive or negative—to ensure an effective and sustainable growth response.

Model Diagnostic Tests

To ensure the validity and efficiency of the employed regression model, this study conducted several diagnostic tests aimed at evaluating the core assumptions of the model and verifying the reliability of the derived results.

These tests include:

1- Heteroskedasticity Test: This test is used to detect the presence of heteroskedasticity in the model's errors, a key assumption for ensuring the efficiency of ordinary least squares (OLS) estimates and the accuracy of standard errors. A widely used method is the Breusch–Pagan–Godfrey test, which allows for the detection of irregular error variance without assuming normality of the residuals (Harvey, 2024: 851).

2- Specification Test: This test aims to verify whether the model is correctly specified, i.e., free from omitted variables or functional form misspecifications. The Ramsey RESET test is commonly employed, which involves regressing the dependent variable on its fitted values raised to higher powers. A high p-value (greater than 0.05) indicates insufficient evidence to reject the null hypothesis, suggesting that the model is correctly specified and accurately captures the relationships among the variables (Al Khatib & Kanaan, 2023: 15).

Table 6. Diagnostic Tests *(EViews 13 output)*

Test	Key Statistics	(p-value)	Interpretation
Breusch–Pagan–Godfrey	F = 0.6499 Obs*R^2 = 19.6217	0.8259 / 0.6646	There is no heteroskedasticity.
Ramsey RESET	F = 1.9962	0.1812	The model is correctly specified.

Structural Stability Tests

CUSUM and CUSUM of Squares tests are employed to detect structural changes in economic models, particularly within the context of linear specifications. The CUSUM test is sensitive to shifts in the level of variables, whereas the CUSUM of Squares test is used to identify changes in the variance of errors. These tests are commonly applied in time series analysis to assess model stability and to determine whether structural changes affect the reliability of the estimated parameters (Ploberger, 2009: 336)**.**

CUSUM and CUSUM of Squares tests were conducted to assess the stability of the regression model's coefficients over the estimation period. The results indicate that the cumulative plots for both tests remained entirely within the 5% significance confidence bounds throughout the observation period, without crossing either the upper or lower limits. This clearly demonstrates the stability of the estimated relationships and the absence of structural breaks or shifts in the model's specification or in the employed time series. These findings suggest that the estimated parameters are statistically stable and generalizable, thereby enhancing the

reliability of the estimates and the efficiency of the associated statistical tests. Accordingly, the model can be confidently employed for economic inference, analysis, and forecasting.

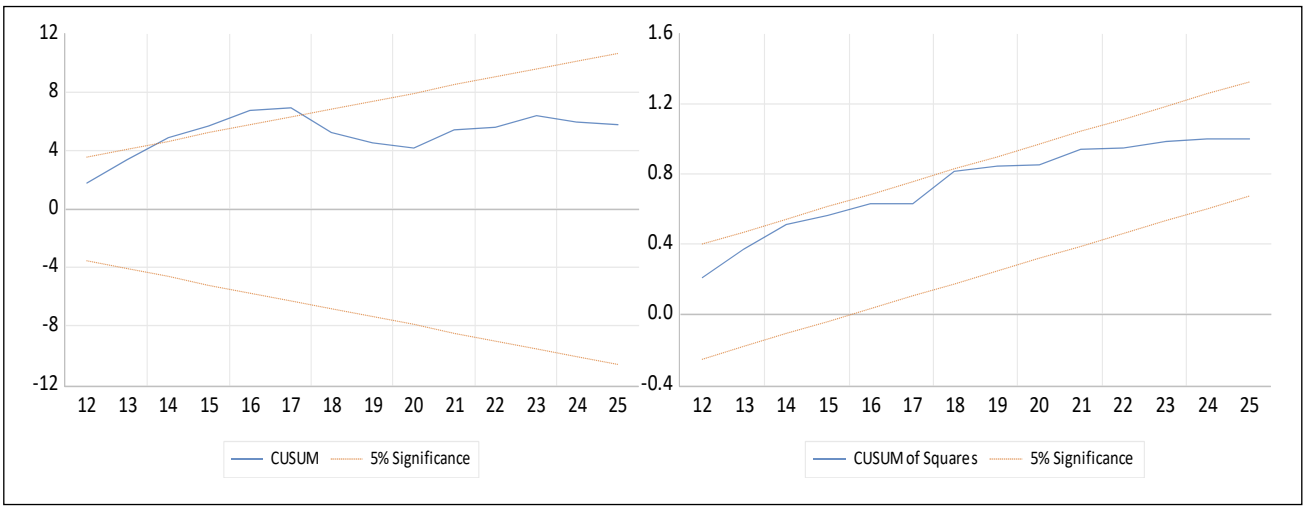

Figure 1. CUSUM and CUSUM of Squares Test *(EViews 13 output)*

Predictive Performance

The predictive performance test is a statistical tool employed to evaluate the accuracy of forecasting models by comparing actual and predicted values. Multiple quantitative indicators are commonly used in this context, including the Root Mean Squared Error (RMSE), which reflects the magnitude of deviations between predicted and actual values; the Mean Absolute Error (MAE), which directly measures the size of errors; and the Mean Absolute Percentage Error (MAPE), which expresses deviations relative to actual values. In addition, the Theil inequality coefficient is often applied to assess model efficiency against a naïve or random benchmark. The primary purpose of this test is to determine the model's suitability for practical applications and to support economic decision-making on the basis of more reliable results (Armstrong & Collopy, 1992: 70).

The accuracy of forecasting per capita GDP growth was evaluated using annual data for 1988–2025 by comparing predicted (GDP_PER_CAF) and actual values. Results indicate satisfactory efficiency, with RMSE of 3.03 and MAE of 1.92, reflecting limited deviations. The Theil Inequality Coefficient was low (0.076) with a negligible Bias Proportion (0.0002), suggesting no systematic bias, while a high Covariance Proportion (≈0.998) shows that most errors stem from random variation rather than model misspecification. Although MAPE (123%) and symmetric MAPE (47.5%) reflect volatility in some periods, the Theil U2 coefficient (0.28) confirms the model's reliability in capturing the overall dynamics of per capita GDP growth.

Thus, the model provides reasonable predictive accuracy and can support long-term economic policy analysis, despite the need for sub-models or additional variables to account for sharp cyclical fluctuations.

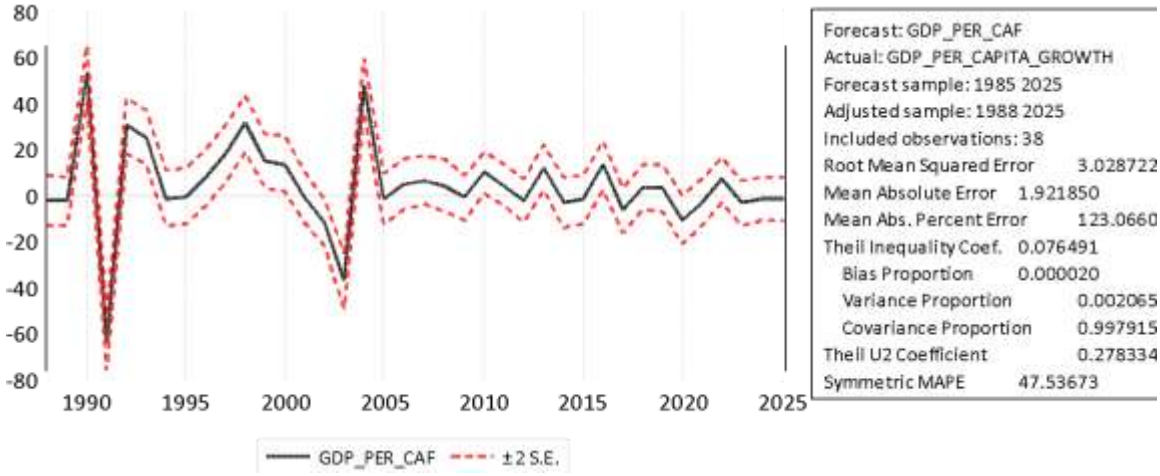

Figure 2. Comparison Results Between Actual and Predicted Values *(EViews 13 output)*

Analysis of Coefficient Restrictions Using the Wald Test

The Wald test is one of the fundamental statistical procedures employed to assess hypotheses concerning the parameters of models estimated through the Maximum Likelihood method. The test is based on comparing the difference between the estimated parameter values and those hypothesized under the null, adjusted by the estimated variance of these parameters. A key advantage of the Wald test lies in its ease of application, as it requires estimation of only the unrestricted model. However, its reliability is heavily dependent on asymptotic assumptions, which may limit accuracy in small samples or when parameters lie near the boundary of the parameter space. Recent studies further suggest that the Wald test may perform less robustly than the Likelihood Ratio or Score tests in certain contexts, particularly when the imposed restrictions are complex or nonlinear (Silvapulle, 1995: 334).

Table 7. Wald Test *(EViews 13 output)*

Test	Statistic	df	Probability
F-statistic	30.899	(5,14)	0.0000
Chi-square	154.496	5	0.0000

Causality Test

The Wald test within the framework of VAR Granger Causality/Block Exogeneity is employed to examine the presence of Granger-causal relationships among variables in a Vector

Autoregression (VAR) model. The test is based on the null hypothesis that the lagged values of a given set of variables do not contribute to explaining or predicting the value of another variable within the system—implying that the corresponding coefficients are jointly equal to zero. Rejecting this null hypothesis using the Wald test indicates that the variables in question are not "exogenous," but rather exert a causal influence on other variables in the system. Accordingly, the test serves as a standard tool for assessing block exogeneity and Granger causality in multivariate VAR models (Fang & Chung, 2025: 1–17).

Table 8. VAR Granger Causality / Block Exogeneity Wald Tests *(EViews 13 output)*

Excluded	Chi-sq	df	Prob.
FOREIGN_DIRECT_INVESTMENT	0.671712	2	0.7147
ENERGY_USE	1.572396	2	0.4556
INFLATION	5.370666	2	0.0682
TRADE	7.664298	2	0.0217
GROSS_CAPITAL_FORMATION	4.636689	2	0.0984
All	20.52374	10	0.0247

The results of the Wald test (Granger Causality / Block Exogeneity) reveal the causal relationship between economic variables and economic growth. The findings indicate that trade is the only variable exerting a statistically significant causal effect on growth ($p = 0.0217$). In contrast, other variables such as foreign direct investment and energy use did not display significant individual effects, while inflation and gross fixed capital formation exhibited marginal significance ($p \approx 0.07–0.10$). When considering the joint effect of all variables, however, the test demonstrates that the interaction among the full set of economic determinants has a significant impact on economic growth ($p = 0.0247$). This underscores that growth is shaped by an interconnected network of economic factors rather than by any single variable in isolation. These results highlight the importance of adopting comprehensive economic policies that prioritize trade and investment while accounting for the interactive dynamics among different growth determinants.

CONCLUSION

This study examined the dynamics of economic growth in Iraq, with a particular focus on per capita GDP growth, highlighting the economy's vulnerability to external shocks and oil market fluctuations. The findings confirm that volatility in oil revenues continues to serve as the primary driver of economic performance, while the contribution of non-oil sectors remains limited. The evidence further demonstrates that expansionary periods fueled by rising oil prices are often unsustainable and typically followed by contractionary cycles, underscoring the structural fragility of a rentier economy dependent on a single resource.

At the theoretical level, this study contributes to the literature on resource-dependent economies by providing empirical evidence on the asymmetric effects of global shocks on the trajectory of per capita growth in Iraq. It also adds value to the academic debate on the "resource curse" and the "Arab growth paradox," by illustrating how oil dependence undermines the stability of individual welfare indicators, even during periods of elevated aggregate revenues.

PROPOSED POLICIES AND RECOMMENDATIONS

- Economic Diversification Priority: Policymakers should prioritize the rapid diversification of the production base by investing in agriculture, industry, and digital services, thereby reducing the economy's exposure to oil price volatility.
- Fiscal Management and Stability: The establishment of stable fiscal mechanisms—such as sovereign wealth funds and countercyclical fiscal rules—can help smooth income fluctuations and ensure the sustainability of public expenditure.
- Human Capital Development: Expanding targeted investments in education, healthcare, and vocational training will enhance labor market efficiency and foster long-term productivity growth.
- Exchange Rate and Inflation Stability: Safeguarding exchange rate stability and maintaining inflation control are fundamental prerequisites for ensuring that per capita income growth translates into genuine improvements in living standards.
- Private Sector Empowerment: Promoting private sector participation through regulatory reforms and facilitating access to finance is essential for job creation and for reducing reliance on oil revenue–financed public employment.
- Future Research Directions: The study recommends further research on the nonlinear and asymmetric dynamics between oil shocks, macroeconomic variables, and growth outcomes, using advanced econometric frameworks such as NARDL and Panel GMM. Additionally, comparative analyses of oil-dependent economies in the Middle East and North Africa (MENA) region would provide a broader regional perspective and enrich the understanding of the Iraqi case.

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