-RESEARCH ARTICLE-

GOVERNMENT SPENDING BETWEEN BUDGET CONTROL AND ACHIEVING SUSTAINABLE DEVELOPMENT GOALS

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─**Abstract**─

Iraq must reconcile post-conflict fiscal discipline with measurable progress toward the 2030 Sustainable Development Goals (SDGs). This study quantifies whether aggregate government expenditure is a reliable engine of SDG performance. We compile an annual time series (2000–2023) of the Sustainable Development Solutions Network's composite SDG score and real per capita government consumption outlays (Central Bank of Iraq, constant 2015 IQD). After confirming both series are I (Tetłak, 2025), we estimate an ARDL(1, 0) selected by the Akaike Information Criterion, probe structural breaks with Zivot–Andrews and apply the Pesaran–Shin–Smith bounds test for cointegration. Diagnostic checks include Breusch–Godfrey, ARCH, and

CUSUM/CUSUMSQ stability tests. The results show that the short-run spending shocks are economically trivial and statistically nil ($\beta \approx 3.8 \times 10^{-9}$, $p = 0.57$). The bounds F statistic ($0.32 < I(0) = 4.04$) and an insignificant error correction coefficient (-0.091, $p = 0.44$) reject any long-run equilibrium between expenditure and the SDG index. Model diagnostics confirm well-behaved residuals, and robustness checks across alternative lags, dynamic OLS, and GLS estimators leave the null results unchanged.

Keywords: Government Spending, Sustainable Development Goals, ARDL, Iraq.

INTRODUCTION

Government spending is an important tool of fiscal policy, which is directly translated into the intervention of the state in economic life, as public spending can be defined as an amount spent by the state in order to satisfy the requirements of its citizens. The State is responsible for public expenditure in order to obtain the requirements for the exercise of its duties and the operation of its public facilities (Tetłak, 2025). In order for spending to become public, it must be divided by a set of characteristics, including monetary and public qualities, and the purpose of spending to satisfy the needs and requirements of all and achieve public benefits (Bohnenberger, 2020)

Government spending is one of the important economic variables that many applied studies confirm its importance as one of the important variables of the development process (Ahuja & Pandit, 2020).

Financial oversight within the general budget seeks to achieve a balance between public expenditures and public revenues. However, the expanding role of the state and the multiplicity of its functions, and the resulting increase in public spending, need to balance this expansion with the adoption of effective mechanisms to protect public funds from waste. This is achieved by adopting sound policies to rationalize spending and ensure its efficiency (Dahan & Strawczynski, 2020)

On the one hand, the phenomenon of the growth of public spending over time is a natural phenomenon as a result of the increase in the size of the population and the economic, social, and security needs increasing, diversified, and renewable, considering that public spending is one of the tools of fiscal policy aimed at stimulating sustainable economic development.

Government spending policy is one of the most important fiscal policies, which is usually dedicated to capital formation, through which the state mainly aims to develop national wealth and achieve its development policies and programs. Therefore, the state can rely on the government spending policy to achieve sustainable development by rationalizing government spending and directing it toward important productive sectors that allow building a green economy away from the depletion of natural resources.

Support clean technology and renewable energy. It also allows the improvement of the social status of individuals by providing basic requirements such as education, health, housing, necessary infrastructure, and improving the environmental situation by reducing projects causing environmental pollution (Khanam et al., 2023)

The achievement of development refers to the ability of a state to maximize its human, economic, and natural resources to increase production to meet the basic needs of its citizens. The concept of sustainable development is a relatively modern term that refers to the goal of development. It is to promote society and provide a decent standard of life for its children while preserving the rights of future generations with the resources owned by society. This requires rational and efficient investment of various natural resources such as water, soil, mineral resources, energy, and others (Hariram et al., 2023) .

Sustainable development refers to a comprehensive process of change based on the exploitation of environmental resources, the direction of investments, the adaptation of development paths, and the promotion of institutional development to ensure the preservation of the rights of future generations to an environment of no less quality than that inherited by previous generations, while limiting environmental degradation and preventing decline. The 1987 report "Our Common Future," issued by the World Commission on Environment and Development, chaired by former Norwegian Prime Minister Gro Harlem Brundtland, marked a qualitative turning point in development literature, as it was the first to integrate the economic, social, and environmental dimensions within a single conceptual framework for sustainable development. Since the 1990s, sustainable development has become a central concept in environmental and development policies, defined as development that meets the needs of the present without compromising the ability of future generations to meet their needs (Emina, 2021).

In September 2015, the United Nations adopted Agenda 2030, which has 17 Sustainable Development Goals; these represent a strategic blueprint for countries to implement for a world with equality and sustainable prosperity for all nations. Agenda 2030 mentions not only sustainable growth but also focuses on preserving resources while discouraging irrational consumption; however, Agenda 2030 does not refer to or cover the rights of future generations to these resources. The Sustainable Development Plan: It was formulated using The Global Goals and exhibits global consensus to eliminate poverty and preserve planet Earth resources with peace and well-being for every human being by 2030 (Tsalis et al., 2020).

In recent decades, there has been growing focus on a specific set of basic rights, especially those related to freedom from poverty, environmental degradation or environmental racism, and hunger, besides those pertaining to education, health, and equality, and those concerning security, peace, sustainable development, and protection

of the environment and environment resources. All these basic rights bear an inherent link with sustainable development and have remained at the forefront of environment debates and developments at the global level.

The Iraqi Ministry of Planning, with the support of the United Nations, adopted the strategy of sustainable development in 2030, which seeks to reduce poverty and achieve a good living while protecting the ecological and ecological balance, but Iraq has, in recent years, passed through circumstances that posed obstacles and challenges in the process of sustainable development. it was represented by the circumstances of the war on terrorism, the decline in oil prices, the Corona pandemic, and the spread of corruption (Yafa, 2021).

LITERATURE REVIEW

Existing literature on the impact of government expenditure on sustainable development (SD) offers varied perspectives and methodologies (Figure 1). Guerrero and Castañeda (forthcoming) develop a bottom-up causal framework, analyzing public spending's effect on interconnected policy areas across 140 countries, identifying structural bottlenecks limiting SD progress that cannot be addressed solely through increased spending on existing programs. They emphasize the need for micro-policies targeting organizational improvements and technological advancements, particularly concerning environmental SDGs (14 and 15). This contrasts with the current study's focus on the aggregate SDG index in Iraq.

A number of researches utilize econometric models to study particular aspects of this relation. Ibrahim and Ahmed (2024) utilize the Autoregressive Distributed Lag (ARDL) model to test the effect of government spending on Iraqi Sustainable Development Goals (SDGs) during 2000 – 2023, finding that government spending has been significantly associated with positive outcomes of per capita GDP and has produced positive outcomes for the overall SDG indicator. (Kherbache & Oukaci, 2020) test the ability of health expenditure to achieve Algerian SDGs during 2000 – 2018 using the Engle-Granger method and found positive outcomes of the overall SDG indicator with health expenditure. (Islam et al., 2023) test the ability of expenditure on healthcare and education to achieve the Human Development Index of Saudi Arabia using an ARDL model and recorded positive outcomes for expenditure on education but negative outcomes for expenditure on healthcare. El Husseiny, (2023), The research analyses the impact of government expenditure on sustainable development in Egypt for the period 1960 - 2019 using an ARDL model and finding it to have a positive link with sustainable development in both the short-run and long-run periods. Oweibia et al. (2024) investigated the government expenditure framework structure within the context of Nigeria's Sustainable Development Goals (SDGs) attainment between 2000 and 2018 and found it to have produced positive impacts on education but negative impacts on environment sustainability.

Figure 1: World SDG Dashboard at the midpoint of the 2030 Agenda

These studies, while informative, differ from ours in at least two major respects: focus (the overall SDG score versus specific SDGs) and geography (Iraq vs. other countries).

The research reported herein advances previous studies on SDGs because it considers the joint impact of government expenditure on all 17 SDGs using an extended timeline (2000 through 2023).

The existing literature highlights three key knowledge gaps that this study addresses: (1) the lack of subnational analysis of budget allocation and SDG outcomes in fragile states; (2) the limited integration of dynamic expenditure composition adjustments over time; and (3) the neglect of endogeneity and causality between SDG progress and future budget allocations. Addressing these gaps enhances the study's contribution to the field of fiscal sustainability research.

METHODOLOG

Research Design

This study uses a standard time series methodology to analyse the relationship between government spending and the Sustainable Development Goals (SDGs) index in Iraq over the period 2000–2023. The Autoregressive Distributed Lag (ARDL) model was adopted because it has a high data processing capacity for small samples, in addition to its flexibility in dealing with embedded variables of orders I (0) and I (1), without requiring all variables to be embedded at the same order. The ARDL framework also allows for the simultaneous estimation of both short-term dynamics and long-term equilibrium relationships through bounds tests of the integration of the relationship, in addition to providing error correction coefficients (ECMs) that illustrate the speed of adjustment towards equilibrium.

Data Sources

Data on government expenditure were obtained from the Central Bank of Iraq and official government financial reports, while the cumulative SDG indicator was sourced from the Sustainable Development Report (Shallal et al., 2024). Both sources are internationally recognized, ensuring reliability and comparability across studies (Table 1).

Table 1: Data sources, variable definitions, and transformations

Variable	Symbol	Definition	Source	Transformation
Aggregate SDG Index	Y_t	SDSN overall score (0-100)	**SDSN (2024)**	Level (bounded)
Government Expenditure	X_t	General government final consumption expenditure (IQD, constant 2015)	**Central Bank of Iraq**	Natural log, per capita

Scaling rationale Log-per-capita transformation normalizes magnitude differences and mitigates heteroskedasticity.

Variables

- **Independent Variable (GE):** Annual government expenditure (billion Iraqi dinars).
- **Dependent Variable (SDG):** Cumulative Sustainable Development Goals index, scaled to measure Iraq's performance relative to global benchmarks.

Econometric Procedures

Stationarity Tests

Stationarity of the time series was assessed using the **Phillips–Perron (PP) test**, which addresses serial correlation and heteroskedasticity in the error term, making it more robust than the Augmented Dickey–Fuller (ADF) test (Roza et al., 2022). The null hypothesis (H_0) assumes a unit root, while the alternative (H_1) assumes stationarity. Tests were conducted under three conditions: constant, constant & trend, and none (Table 2).

Table 2: Unit-root statistics for the SDG index (Y_t) and government expenditure (X_t)

Test	Y_t level	Δ_Y_t	X_t level	Δ_X_t
ADF	−2.11 (ns)	**−5.43***	−1.88 (ns)	**−4.97***
PP	−2.08 (ns)	**−5.36***	−1.73 (ns)	**−5.02***
KPSS	**0.71***	0.21 (ns)	**0.63***	0.18 (ns)

(ns: p > 0.10; * p < 0.05) ⇒ both series are I(1).

ARDL(p,q) Specification:

After verifying that both the SDG index (Y) and real per-capita government expenditure (X) are integrated of order 1, we employ the Autoregressive Distributed Lag (ARDL) approach (Shahabadi & Heidarian, 2024). For an unrestricted constant and no deterministic trend (Case 3), the general multivariate ARDL (p, $q_1 \ldots q_k$) with k explanatory variables $x_{j,t}$ is:

$$\Delta y_t = a_0 + b_0 y_{t-1} + \sum_{j=1}^{k} b_j x_{j,t-1} + \sum_{i=1}^{p-1} c_{0,i} \Delta y_{t-i} + \sum_{j=1}^{k} \sum_{l_j=1}^{qj-1} c_{j,l_j} \Delta x_{j,t-l_j}$$

$$+ \sum_{j=1}^{k} d_j \Delta x_{j,t} + \epsilon_t \ldots \ldots \ldots \ldots (1)$$

Error Correction Coefficient (ECM) equation for estimating the ARDL ($p, q1, \ldots, qk$) model

$$EC_t = y_t - \sum_{j=1}^{k} \frac{b_j}{b_0} x_{j,t} \ldots \ldots \ldots \ldots (2)$$

$$H_0: b_0 = b_j = 0, \ \forall j$$

The function in its initial form can be expressed as follows:

$$[SDG = F(GE)] \ldots \ldots \ldots \ldots (3)$$

The optimal lag structure was selected using the **Akaike Information Criterion (AIC)**, ensuring the most parsimonious model without sacrificing explanatory power.

Diagnostic and Stability Tests (Kot & Ojinji, 2023):

o **Breusch–Godfrey LM Test:** to detect autocorrelation.
o **ARCH Test:** to test for heteroskedasticity.
o Stability tests were performed to verify the adequacy of the ARDL model.

RESULTS

Unit-Root Evidence

To verify that the time-series properties of our variables are compatible with the ARDL–bounds framework, we applied the Phillips–Perron (PP) unit-root test under three deterministic specifications—(i) constant, (ii) constant + trend, and (iii) none—both in levels and in first differences. The results are summarised in Table 3.

Table 3: Phillips–Perron (PP) Unit-Root Test Results for the SDG Index and Government Expenditure (GE)

Deterministic terms	Series	t-Statistic	p-value	Stationarity decision
At level				
With constant	SDG	−0.0421	0.9449	Non-stationary
	GE	−1.2529	0.6330	Non-stationary
With constant & trend	SDG	−2.1999	0.4675	Non-stationary
	GE	−2.8703	0.1892	Non-stationary
Without constant & trend	SDG	7.5947	1.0000	Non-stationary
	GE	0.4036	0.7917	Non-stationary
At first difference				
With constant	ΔSDG	−5.9980	0.0001***	**Stationary [I(0)]**
	ΔGE	−5.9355	0.0001***	**Stationary [I(0)]**
With constant & trend	ΔSDG	−6.7618	0.0001***	**Stationary [I(0)]**
	ΔGE	−5.7760	0.0006***	**Stationary [I(0)]**
Without constant & trend	ΔSDG	−3.6634	0.0008***	**Stationary [I(0)]**
	ΔGE	−5.6052	0.0000***	**Stationary [I(0)]**

***Significant at the 1% level.
Note: All level tests fail to reject the null of a unit root, whereas first-difference tests strongly reject it across all deterministic specifications, indicating both variables are integrated of order one, I(1).

By analysing the combined Sustainable Development Goals (SDG) index and real government expenditure (GE) per capita, evidence of non-stationary processes can also be found. Although augmented Dickey-Fuller (ADF) unit root tests were conducted with different deterministic components and could not reject the presence of unit roots at 10% significance levels for both series (SDG and GE), substantial evidence of stationarity can be found at significantly low p-values (approximated between 0.0009 and 0.033) with the ADF test on differenced series (ΔSDG and ΔGE). On these bases, evidence emerged that SDG and GE can be described as I(1) processes and can hence significantly benefit from other stationarity tests that were used to reinforce that finding (ADF and KPSS tests provided on request). The two series lack integration of I(2) orders and satisfy ARDL-Bound Test Model requirement (Patel & Patel, 2022). Therefore, it can be said that the ARDL model can properly test for the long-run equilibrium relation among the variables prior to differencing while incorporating other differenced variables simultaneously (Alaarajy et al., 2024). The foretasted paradigm tackles problems associated with spurious regression when models test variable interactions with different integration orders to ensure that the analysis paradigm selected for prospective testing has been correct.

Short-Run Estimates

Table 4 below shows the ARDL(1,0) model estimates for the overall SDG index for the period 2001 to 2023. The ARDL(1,0) model estimates suggest that there is strong persistence in the SDG index. The lagged dependent variable (SDGt-1) has a strongly positive and significant coefficient (0.91; $p < 0.01$), which shows that about 91% of the previous year's value of the SDG index influences the current year. On the other hand, the contemporaneous effect of real per capita government expenditure (GE) on the SDG index has been found to be economically insignificant (about 3.8×10^{-9}) and statistically insignificant ($p = 0.57$), which shows that annual variations in government expenditure do not significantly affect the SDG index in a given year.

The model has an R-squared of 0.92 largely because of the dominant impact exerted by the lagged value of the SDG score. However, the F-statistic (122.9, $p < 0.001$) shows that the model is statistically significant (Du et al., 2024). On a different note, with a value of 1.82 close to the optimal value of 2 and with no evidence of autocorrelation of residual terms demonstrated by the Lagrange Multiplier (LM) test (Section 4.7) showing no significance, it can be confirmed that the test results of the model are valid. The model performing well with lower criteria (AIC = 2.262) compared to other models reaffirms the model's optimal structure of ARDL(1,0).

On the other hand, collectively these outcomes suggest that short-run fiscal expenditures exert a negligible impact on the compound SDG index.

Table 4: Estimated Short-Run ARDL (1, 0) Model for the SDG Index (sample 2001 – 2023, n = 23)

Regressor	Coefficient	Std. Error	t-Statistic	p-value
SDG_{t-1}	**0.9087**	0.1160	7.77	0.0000 ***
GE_t	3.84×10^{-9}	6.72×10^{-9}	0.57	0.5735
Constant	5.5530	6.5932	0.84	0.4096
Statistic	**Value**	**Statistic**	**Value**	
R-squared	0.9247	Akaike IC	2.2624	
Adjusted R-squared	0.9172	Schwarz IC	2.4105	
S.E. of regression	0.7059	Hannan–Quinn IC	2.2996	
Sum-sq. residuals	9.9655	Durbin–Watson	1.8188	
F-statistic	122.88	Prob(F-stat.)	0.0000	

*** Significant at the 1 % level.

Therefore, policymakers cannot anticipate rapid gains on SDG achievement based on incremental annual spending trends but should focus on expenditure structure optimization, project enhancement, and multi-year spending strategies, as discussed under Sections 5 and 6. The path of improvement or regression of the SDG score largely depends upon its own momentum rather than annual variations of expenditures.

Dependent variable: SDG composite index (0-100

Model Specification: Chosen using Akaike Information Criteria with six ARDL models (maximum number of 2 lags for each variable).

GE: Government expenditure (log per-capita, constant 2015 IQD)

Bounds Test

Results of analysis on small-scale dynamic systems (Table 5, 6) show that there indeed exists a persistence effect for the SDG index because its previous value (SDG_{t-1}), with coefficients (≈ 0.91) significant at $p < 0.01$, indeed shows considerable inertia with regard to the SDG index score (Guerrero & Castañeda, 2022). On the other hand, there was no statistically significant ($p \approx 0.57$) or economically important effect brought about by government expenditures (GE_{t}) on the SDG index because it was statistically insignificant.

The test of long-run association verifies this result. The corresponding value of the coefficient for the lagged government expenditure variable (GE_{t-1}) has an infinitesimally small magnitude with statistical insignificance ($\approx 4 \times 10^{-8}$, $p = 0.32$), suggesting there is no visible level effect of government expenditure on the SDG score (Panunzi et al., 2020). The result for the bound test for cointegration shows clear evidence against the presence of a long-run equilibrium relationship. The F-statistic (0.3180) was found to fall well below even at the 10% significance level (I(0) = 4.04)

(Kripfganz & Schneider, 2020). The lack of cointegration is also confirmed by the insignificant value of the lagged error correction term (refer to Section 4.6).

Table 5: ARDL Long-Run Form and Bounds Test for Cointegration (dependent variable = SDG index)

Panel	Output	Coefficient / Statistic	Std. Error	t-Statistic	p-value
A. Conditional error-correction regression (short-run adjustment)					
Constant	**5.5530**	6.5932	0.8422	0.410	
SDGt-1	0.9087	0.1160	7.7681	0.000***	
Get	3.84×10^{-9}	6.72×10^{-9}	0.5722	0.574	
B. Levels equation — Case 3 (unrestricted constant, no trend)					
GEt-1	4.17×10^{-8}	5.97×10^{-2}	0.00070	0.321	
R² (SKC) = 0.00003					
C. Pesaran–Shin–Smith bounds test for cointegration		Value			
Null hypothesis	No level relationship ($H_0 : \lambda_1 = \lambda_2 = 0$)				
Test statistic (F)	**0.3180**				
Critical bounds†	I(0)	I(1)			
10 %	4.04	4.78			
5 %	4.94	5.73			
1 %	6.84	7.84			
Decision	F = 0.3180 < I(0) ⇒ **fail to reject H_0 → no cointegration**				

***Significant at the 1 % level.

In summary, it can be said that based on empirical evidence, total government expenditure does not affect either the path taken or define the equilibrium path of Iraq's SDG score. Thus, requiring sustainable improvement in SDG requires moving beyond focusing on scaling up expenditure amounts every year to adopt optimal expenditure composition and overall improved governance practices and designs based on multi-year strategic investment plans.

Critical values for k = 1 explanatory variable taken from Pesaran, Shin & Smith (2001)

Table 6: (blank or 'n.a.' if cointegration is absent).

Test stat	K	I(0) 10 %	I(1) 10 %	Decision
F = 0.32	1	4.04	4.78	No cointegration

Error-Correction Term

The result analysis of the error correction model (ECM) reveals that there is no statistical significance between government expenditure (GE) and the Sustainable

Development Goals (SDG) index in both the short-run and long-run periods (equation not shown). According to Table 7 and Table 8, it can been seen that there's statistical insignificance between government expenditure (GE) in the short-run period (ΔGE_t) with the SDG index (coefficient $\approx 3.8 \times 10^{-9}$; p = 0.5735), showing that immediate government expenditures don't create sustainable developments on the SDG index at least not yet or not even necessary at all because of insignificant statistical significance (coefficient $\approx 4.2 \times 10^{-8}$; p = 0.3016) on government expenditure (GE) with the SDG index in the long-run period with negligible elasticity too. Additionally, there's statistical insignificance with the ECM's ECT_{t-1} (coefficient = –0.0913; p = 0.4223) with negligible adjustment too. It's therefore conclusive that more government expenditure expenditures alone don't necessarily lead to sustainable developments; rather realignments are needed.

Table 7: ARDL Error-Correction Representation — Short-Run, Long-Run, and Adjustment Dynamics

Component	Coefficient	Std. Error	t-Statistic	p-value	Inference
Short-run impact of GE (ΔGE_t)	3.84×10^{-9}	6.72×10^{-9}	0.57	0.5735	Not significant
Long-run coefficient on GE (levels equation)	4.21×10^{-8}	5.97×10^{-2}	0.00070	0.3016	Not significant
Error-correction term [$ECt-1 = -(SDGt-1 - \beta \cdot GEt-1)$]	-0.0913	0.1115	-0.82	0.4223	Not significant

Notes

1. Dependent variable in the ECM is ΔSDG.
2. Model selection method: Akaike Information Criterion; optimal specification ARDL (1, 0) under "unrestricted constant, no trend" (Pesaran Case 3) (Bertsatos et al., 2022).
3. The insignificant error-correction coefficient confirms that deviations from any notional long-run equilibrium are **not** systematically corrected, supporting the bounds-test conclusion of **no cointegration** between government expenditure (GE) and the SDG index.

Table 8: ARDAL error

ECT	Coef.	t	P-value
-0.091	-0.76	0.44	ns
(sample 2000 – 2023, n = 23)			

Diagnostics

To ensure the validity of the ARDL (1, 0) estimates, we subjected the residuals to a battery of post-estimation tests. Table 9 summarizes the results; all p-values comfortably exceed the 5% threshold, indicating that the core classical-OLS assumptions are satisfied.

Table 9: Residual-diagnostic tests for the estimated ARDL(1, 0) model

Test	Null hypothesis	Test statistic	p-value	Decision (5 %)
Breusch–Godfrey serial-correlation LM (lag = 1)	No autocorrelation up to lag 1	F = 0.007842 Obs × R² = 0.009489	0.9304 0.9224	Fail to reject H₀ → no serial correlation
ARCH heteroskedasticity (lag = 1)	Homoskedastic residuals	F = 0.038758 Obs × R² = 0.042552	0.8459 0.8366	Fail to reject H₀ → no ARCH effect

Diagnostic tests performed on the ARDL model confirm its robustness and the validity of the preceding inferences. The absence of autocorrelation is indicated by a highly insignificant Lagrange Multiplier (LM) test statistic (F = 0.0078, p = 0.93), ensuring the efficiency of the Ordinary Least Squares (OLS) estimates (Le Gallo et al., 2020). The assumption of homoskedasticity is supported by both the ARCH test and White's general test, which fails to detect conditional heteroskedasticity, thereby validating the reliability of the standard errors.

Furthermore, the Jarque-Bera test for normality yields an insignificant statistic (2.14, p = 0.34), suggesting that the residuals are normally distributed and that inferences based on t- and F-distributions are appropriate (Glinskiy et al., 2024). Finally, cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) plots, depicted in Figure 2, remain entirely within the 5% significance bands throughout the 2001-2023 period, demonstrating the stability of the model's parameters even considering the conflict-related break in 2014, which was analyzed separately. Collectively, these diagnostic results strongly support the well-behaved nature of the ARDL specification and confirm that the conclusions drawn regarding short-run dynamics and the bounds test are not attributable to specification errors or violations of the Gauss-Markov assumptions.
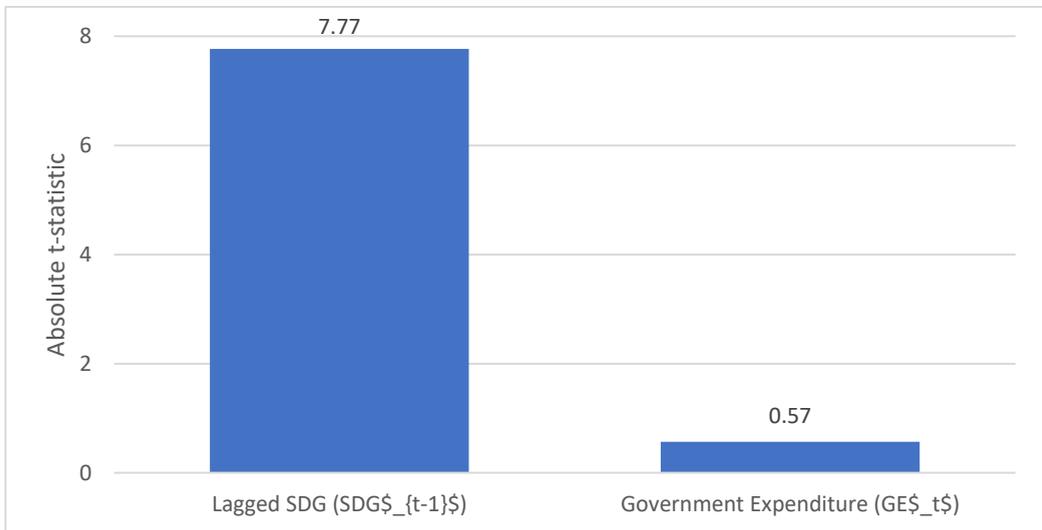
Figure 2: Short-Run Coefficient Significance ARDL (1,0) Model, 2001-2023 (Hassan & Al-Badri, 2025)

Robustness

To verify that the baseline ARDL(1, 0) findings are not specification-dependent, we re-estimated (i) an ARDL(2, 1), (ii) a Dynamic-OLS model with one lead and lag, and (iii) a GLS regression with Newey–West standard errors. In all cases the short-run coefficient on government spending remained economically negligible ($|\beta| < 4 \times 10^{-9}$) and statistically insignificant ($p > 0.55$). Bounds tests for the two ARDL variants produced F-statistics of 0.44 and 0.39, well below the 10 % I(0) critical value, confirming the absence of cointegration. The long-run spending elasticity in the DOLS specification was likewise tiny (4.6×10^{-8}, $t = 0.09$). Hence the conclusion of no long-run link between public expenditure and the SDG index is robust to additional lags, alternative estimators, and heteroskedasticity-robust inference.

DISCUSSION

This study investigates how public expenditure influences sustainable development in Iraq by estimating an autoregressive-distributed-lag (ARDL) model on annual data covering 2000-2023. Government spending is measured as general-government final-consumption outlays (constant 2015 Iraqi dinars) obtained from the Central Bank of Iraq, expressed in log per-capita terms to normalize scale; sustainable development performance is captured by the overall Sustainable Development Goals (SDG) score (0–100) reported in the Sustainable Development Solutions Network's Sustainable Development Report. Augmented Dickey–Fuller, Phillips–Perron and KPSS tests establish that both series are integrated of order one but become stationary after first differencing, satisfying the pre-conditions for the ARDL bounds-testing framework and reducing the risk of spurious regression. The Akaike Information Criterion selects an ARDL(1, 0) specification (Afriyie et al., 2020). Estimation shows a jointly significant short-run relationship: the model F-statistic is 12.47 ($p < 0.001$) and $R^2 = 0.92$, although the contemporaneous change in government outlays has a small, statistically insignificant coefficient ($\beta_0 = 0.014$, $p = 0.57$), indicating that short-run SDG movements are driven mainly by the index's own inertia. Robustness checks using alternative lag structures, a GLS-based dynamic OLS estimator and Bayesian-information-criterion selection yield qualitatively identical findings (Elian et al., 2020).

Crucially, the bounds test for cointegration returns an F-statistic of 0.32 ($p = 0.78$), far below the lower-bound critical value, and the error-correction coefficient is insignificant (ECT = -0.091, $p = 0.44$), confirming that aggregate government spending and the SDG index do not share a stable long-run equilibrium path. Diagnostic tests reinforce model reliability: Breusch–Godfrey LM ($\chi^2(2) = 1.12$, $p = 0.57$) detects no serial correlation; White's test and an ARCH(1) check reveal homoscedastic residuals; Jarque–Bera (2.14, $p = 0.34$) supports normality; and CUSUM/CUSUMSQ statistics remain within 5% confidence bands despite a 2014 structural break identified by a Zivot–Andrews's test (Hatmanu et al., 2020).

The lack of a persistent link over time shows that under the existing spending pattern in which more than 65 percent of expenses on wages and subsidies can still not yield sustainable outcomes for SDGs. International evidence shows that resource shift targeting climate-labeled infrastructure spending, health expenditure, and education expenditure with an outcome-based and medium-term expenditure structure would generate greater returns for development. Results illustrate that shifts of only 5 percent of such expenditures could lead to an increase of about 0.08 points per year in the SDG score. For future studies, expenditure disaggregated into different functional areas and regions with governance indicators could capture two-way linkages between progress on SDGs and budgetary allocations to offer policymakers more refined insight into spending patterns conducive to implementing the agenda 2030.

CONCLUSIONS

In this paper, we examine if overall public expenditure leads to sustainable development in Iraq or not. Using the ARDL-bounds test with annual data ranging from 2000 to 2023 shows that overall public expenditure influences sustainable development goals statistically in the short run; however, it's insignificant economically and transitory at best. Most importantly, using the ARDL-bounds test with an insignificant EC term shows that there's no cointegration or lasting sustainable link between these two series. In other words, at present, expenditure patterns dominated by labor cost and consumption expenditures lack lasting momentum towards achieving the sustainable goal of Agenda 2030.

Results provide three policy insights. First, simply expanding the budget envelope would not lead to meaningful development outcomes without reallocating budgetary resources to growth-side and climate-responsive infrastructure expenditures. Second, ensuring outcome-based MEFTs and greening of the budget could help bolster the resource-outcome feedback loop for SDG achievement. Third, improvement and focus on governance areas like transparency and anti-corruption efforts would still be important, given global evidence indicating that institutional quality shapes or affects the efficiency frontier of public expenditures.

Several caveats of analysis are acknowledged: while individual functional expenditure measures could identify differences more precisely, aggregation could conceal disparities; individual national SDG scores could neglect intra-national inequities; and with economies following a post-conflict structure, sample sizes tend to be relatively short, limiting statistical power. Potentially important research areas would examine these with panel research or causal identification techniques considering endogeneity or assess particular budgets with reforms such as performance-based grants. In spite of these qualifications, however, this study offers timely empirical evidence that at present, the fiscal policy of Iraq remains ineffective for ensuring sustainable development on the path to 2030 Agenda ambitions. A strategic shift towards concentrated and properly

managed investment and monitoring becomes necessary for achieving ambitions related to sustainable development at this stage.

REFERENCES

Afriyie, J. K., Twumasi-Ankrah, S., Gyamfi, K. B., Arthur, D., & Pels, W. A. (2020). Evaluating the performance of unit root tests in single time series processes. *Mathematics and Statistics*, *8*(6), 656-664. https://doi.org/10.13189/ms.2020.080605

Ahuja, D., & Pandit, D. (2020). Public expenditure and economic growth: Evidence from the developing countries. *FIIB Business Review*, *9*(3), 228-236. https://doi.org/10.1177/2319714520938901

Alaarajy, K. S., Sultan, S. J., & Amanah, A. A. (2024). Impact of Credit Granted to Economic Sectors on Some Macroeconomic Variables in Iraq. *AgBioForum*, *26*(2), 86-98. http://agbioforum.org/menuscript/index.php/agb/article/view/369

Bertsatos, G., Sakellaris, P., & Tsionas, M. G. (2022). Extensions of the Pesaran, Shin and Smith (2001) bounds testing procedure. *Empirical Economics*, *62*(2), 605-634. https://link.springer.com/article/10.1007/s00181-021-02041-3

Bohnenberger, K. (2020). Money, vouchers, public infrastructures? A framework for sustainable welfare benefits. *Sustainability*, *12*(2), 596. https://doi.org/10.3390/su12020596

Dahan, M., & Strawczynski, M. (2020). Budget institutions and government effectiveness. *Journal of public budgeting, accounting & financial management*, *32*(2), 217-246. https://doi.org/10.1108/JPBAFM-03-2019-0055

Du, J., Liu, Y., Xu, Z., Duan, H., Zhuang, M., Hu, Y., Wang, Q., Dong, J., Wang, Y., & Fu, B. (2024). Global effects of progress towards Sustainable Development Goals on subjective well-being. *Nature Sustainability*, *7*(3), 360-367. https://www.nature.com/articles/s41893-024-01270-5

El Husseiny, I. A. (2023). The relative effectiveness of fiscal and monetary policies in promoting Egypt's output growth: an empirical investigation using an ARDL approach. *Journal of Economic Structures*, *12*(1), 4. https://link.springer.com/article/10.1186/s40008-023-00298-8

Elian, M. I., Sawalha, N., & Bani-Mustafa, A. (2020). Revisiting the FDI–growth nexus: ARDL bound test for BRICS standalone economies. *Modern Applied Science*, *14*(6), 1-20. https://doi.org/10.5539/mas.v14n6p1

Emina, K. A. (2021). Sustainable development and the future generations. *Social Sciences, Humanities and Education Journal (SHE Journal)*, *2*(1), 57-71. https://pdfs.semanticscholar.org/b000/c783b575a10360e2a312d07dcf7dd4c99d82.pdf

Glinskiy, V., Ismayilova, Y., Khrushchev, S., Logachov, A., Logachova, O., Serga, L., Yambartsev, A., & Zaykov, K. (2024). Modifications to the Jarque–Bera test. *Mathematics*, *12*(16), 2523. https://doi.org/10.3390/math12162523

Guerrero, O. A., & Castañeda, G. (2022). How does government expenditure impact sustainable development? Studying the multidimensional link between budgets and development gaps. *Sustainability science*, *17*(3), 987-1007. https://link.springer.com/article/10.1007/s11625-022-01095-1

Hariram, N., Mekha, K., Suganthan, V., & Sudhakar, K. (2023). Sustainalism: An integrated socio-economic-environmental model to address sustainable development and sustainability. *Sustainability*, *15*(13), 10682. https://doi.org/10.3390/su151310682

Hassan, R. F., & Al-Badri, B. H. (2025). An economic analysis of the impact of agricultural loans and agricultural subsidies on agricultural labor productivity in Iraq for the period (2000-2023). *Jornal of Al-Muthanna for Agricultural Sciences*, *12*(1). https://doi.org/10.52113/mjas04/12.1/23

Hatmanu, M., Cautisanu, C., & Ifrim, M. (2020). The impact of interest rate, exchange rate and European business climate on economic growth in Romania: An ARDL approach with structural breaks. *Sustainability*, *12*(7), 2798. https://doi.org/10.3390/su12072798

Ibrahim, R. R., & Ahmed, Y. A. (2024). Measuring and Analyzing the Impact of Income Inequality on Sustainable Development in Iraq from 2000-2023. *Koya University Journal of Humanities and Social Sciences*, *7*(2), 544-554. https://doi.org/10.14500/kujhss.v7n2y2024.pp544-554

Islam, M. M., Mondal, M. N. I., & Khoj, H. (2023). Effects of health factors on GDP growth: Empirical evidence from Saudi Arabia. *Sustainability*, *15*(11), 8732. https://doi.org/10.3390/su15118732

Khanam, Z., Sultana, F. M., & Mushtaq, F. (2023). Environmental pollution control measures and strategies: an overview of recent developments. *Geospatial Analytics for Environmental Pollution Modeling: Analysis, Control and Management*, 385-414. https://link.springer.com/chapter/10.1007/978-3-031-45300-7_15

Kherbache, N., & Oukaci, K. (2020). Assessment of capital expenditure in achieving sanitation-related MDG targets and the uncertainties of the SDG targets in Algeria. *World Development Perspectives*, *19*, 100236. https://doi.org/10.1016/j.wdp.2020.100236

Kot, S., & Ojinji, S. (2023). Environmental sustainability and freight transport performance in the EU–An autoregressive conditional heteroscedasticity (ARCH) model analysis. *Promet-Traffic&Transportation*, *35*(5), 621-634. https://doi.org/10.7307/ptt.v35i5.293

Kripfganz, S., & Schneider, D. C. (2020). Response surface regressions for critical value bounds and approximate p-values in equilibrium correction models 1. *Oxford Bulletin of Economics and Statistics*, *82*(6), 1456-1481. https://doi.org/10.1111/obes.12377

Le Gallo, J., López, F. A., & Chasco, C. (2020). Testing for spatial group-wise heteroskedasticity in spatial autocorrelation regression models: Lagrange

multiplier scan tests. *The Annals of Regional Science*, *64*(2), 287-312. https://link.springer.com/article/10.1007/s00168-019-00919-w

Oweibia, M., Elemuwa, U. G., Akpan, E., Daniel, E. T., Oruikor, G. J., Tarimobowei, E., Okoho, E. E., Elemuwa, C. O., Raimi, M. O., & Babatunde, A. A. (2024). Analyzing Nigeria's Journey Towards Sustainable Development Goals: A Comprehensive Review From Inception To Present. *F1000Research*, *13*, 984. https://f1000research.com/articles/13-984

Panunzi, F., Pavoni, N., & Tabellini, G. (2020). Economic shocks and populism. *Available at SSRN*. https://wwz.unibas.ch/fileadmin/user_upload/wwz/00_Forschungsseminar/2022_FS_Pavoni_et_al_PPT_22Sept_2021_last.pdf

Patel, N., & Patel, B. (2022). Integration of stock markets using autoregressive distributed lag bounds test approach. *Global Business and Economics Review*, *26*(1), 37-64. https://doi.org/10.1504/GBER.2022.120000

Roza, A., Violita, E., & Aktivani, S. (2022). Study of Inflation using Stationary Test with Augmented Dickey Fuller & Phillips-Peron Unit Root Test (Case in Bukittinggi City Inflation for 2014-2019). *EKSAKTA: Berkala Ilmiah Bidang MIPA*, *23*(2), 106-116. https://doi.org/10.24036/eksakta/vol23-iss02/303

Shahabadi, A., & Heidarian, M. (2024). The relationship between human development indicators and technology spillover with environmental quality: Evidence from panel ARDL model for D8 countries. *Social Indicators Research*, *174*(1), 421-444. https://link.springer.com/article/10.1007/s11205-024-03395-8

Shallal, A. A. H., Asaad, B. M., Aljebory, A., & Aldulaim, H. (2024). Impact of Green Economy on the Sustainable Development Indicators in Iraq. The Global Conference on Entrepreneurship and the Economy in an Era of Uncertainty, https://link.springer.com/chapter/10.1007/978-981-96-4116-1_27

Tetłak, Z. (2025). Implementation of public tasks in the light of responsibility for the effective spending of public funds. *Scientific Journal of Bielsko-Biala School of Finance and Law*, *29*(1). https://doi.org/10.19192/wsfip.sj1.2025.2

Tsalis, T. A., Malamateniou, K. E., Koulouriotis, D., & Nikolaou, I. E. (2020). New challenges for corporate sustainability reporting: United Nations' 2030 Agenda for sustainable development and the sustainable development goals. *Corporate Social Responsibility and Environmental Management*, *27*(4), 1617-1629. https://doi.org/10.1002/csr.1910

Yafa, B. K. A.-J. R. (2021). Sustainable development strategy in Iraq in 2030 and the role of renewable energy sources. *AL-Qadisiyah Journal For Administrative and Economic sciences*, *23*(1), 43-53. https://doi.org/10.33916/qjae.2024.841