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-RESEARCH ARTICLE-

SOCIAL EXPENDITURE COMPONENTS AND INCOME INEQUALITY IN IRAQ: AN ECONOMETRIC ANALYSIS CONTROLLING FOR OIL REVENUES AND UNEMPLOYMENT

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─Abstract─

This paper examines the relationship between social expenditure components and income inequality in Iraq during 2004-2025, including the separate effect of social expenditure on education, health, and social protection, in addition to the effect of oil revenues and unemployment rate. In an oil-dependent economy, it investigates the scant evidence on the heterogeneous distributional relationships of these expenditure components within a coherent econometric framework. The research is based on the

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Autoregressive Distributed Lag (ARDL) model and the bounds testing methodology, using original annual data that are temporally disaggregated into estimated quarterly series with the Boot-Feibes-Lisman technique, without considering the resulting values as additional independent economic observations. The results show a cointegrated long-run equilibrium relationship among the variables in the model. Long-term relationships between health spending and the Gini coefficient are estimated to be positive and statistically significant, while spending on education and social protection are estimated to have statistically insignificant long-term relationships. Oil revenues are negatively correlated with income inequality, but unemployment's correlation with income inequality is not statistically significant in the long run. The coefficient on the error correction term shows that about 7.16% of the disequilibrium from the previous quarter is fixed each quarter. This means that the adjustment back to the long-run equilibrium is slow. The study finds that the distributional dynamics of social expenditure components are diverse and stresses the importance of analyzing each component individually when considering income inequality in Iraq, while acknowledging the methodological limitations associated with the disaggregation of temporal data.

Keywords: Social Expenditure; Income Inequality; Education Expenditure; Health Expenditure; Social Protection; Iraq.

JEL Classification: D63; H50; H51; H52; H53.

INTRODUCTION

Income inequality is still a major issue in economic policy because of its implications on household welfare, economic opportunities and social development (Kuznets, 1955). Fiscal policy is related to income distribution through taxation, transfers and public expenditure, in particular expenditure on education, health and social protection. The distributional effects of social expenditure are contingent not only on its magnitude but also on its composition, targeting, efficiency, and the allocation of benefits among income groups (Korpi & Palme, 1998; Mathai et al., 2020). Moreover, empirical evidence suggests that the relationships between expenditure and inequality differ across economic contexts and expenditure categories (Anderson et al., 2017; Malla & Pathranarakul, 2022).

Iraq is a particularly relevant place to study these relationships, as its public finances depend to a large extent on oil revenues. The volatility of oil markets exposes fiscal resources and expenditure allocations. The oil revenue to GDP ratio in the study dataset varied from 27.01% in 2005 to 71.19% in 2022 over 2004-2025, revealing a remarkable diversity in the fiscal environment. During the same period, the Gini coefficient decreased from 0.41 in 2004 to 0.23 in 2015, then rose to 0.31 in 2025. These changes in the priorities of social spending and the conditions of the labour market took place at the same time as these developments, thus raising the question of whether the

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composition of public spending is related to income inequality independently of oil revenues and unemployment.

Expenditure on education, health and social protection are especially important as they operate through different distributional channels (Miranda-Lescano et al., 2024). On the other hand, education expenditure may influence future earnings via human capital accumulation (Becker, 1962), and health expenditure may affect productive capacity and households' financial burdens. The more direct relationship of social protection expenditure is with disposable income through transfers and benefits (Bastagli et al., 2019). But higher spending does not always imply lower inequality, because distributional outcomes depend on access, coverage, targeting and the distribution of benefits across income groups (Korpi & Palme, 1998; Popova, 2023). Thus, it is important to study these components together in Iraq, where oil-dependent fiscal conditions may affect their financing and unemployment may affect households' access to labour income (Mocan, 1999).

Previous studies have examined the relationship between public expenditure and income inequality (Anderson et al., 2017; Bação et al., 2025). However, evidence on Iraq is still lacking on the separate relationships of education, health and social protection expenditures with the Gini coefficient within a unified framework controlling for oil revenues and unemployment. The resulting research gap is whether disaggregating social expenditure reveals distinct distributional relationships that are overlooked by aggregate expenditure measures. Thus, this study investigates the relationships between education, health and social protection expenditures and income inequality in Iraq for the period 2004–2025, controlling for oil revenues and unemployment. The Autoregressive Distributed Lag (ARDL) framework is used to estimate long-run relationships and short-run dynamics. Temporal disaggregation of 22 annual observations provides estimates of the quarterly series, and the analysis incorporates the fact that these constructed values do not provide independent economic information. The study provides Iraqi-specific evidence on the heterogeneous associations of social expenditure components with income inequality, but not on the causality of public spending.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Review of Literature

Empirical studies find mixed evidence on the relationship between social expenditures and income inequality. There are differences in the structure of expenditures, institutional environment, and econometric methods. Mathai et al. (2020) studied government spending on education, health, and social welfare in the Middle East and Central Asia and stressed the importance of effective spending and social results. Ahuja and Pandit (2022) pointed to the negative links between social expenditure components and inequality in developing countries. Malla and Pathranarakul (2022) examined fiscal

policy and institutional capacity in relation to income inequality in developed and developing countries, with results that differ between the two groups. These findings are consistent with the extensive evidence reviewed by Anderson et al. (2017) that the connections between spending and inequality are dependent on the categories considered, the model specifications, and the economic conditions. Thus, the total social expenditure may hide large differences in the distributional dynamics of its separate components.

The literature on education spending typically stresses its possible redistributive function, although the magnitude and sign of the estimated relationship are not uniform. Sylwester (2002) reported that higher public education expenditure is associated with a decline in income inequality in cross-country data, and De Gregorio and Lee (2002) found that educational attainment and a more equal distribution of education are associated with lower income inequality. By contrast, Voto and Ngepah (2024), using fully modified ordinary least squares for sub-Saharan African countries, found that public education expenditure increased income inequality in the long run, while its squared term reduced it. Yet educational attainment and public spending on education are different measures, and cross-national panel data and country-specific time-series models capture different dimensions of economic variation. Thus, these findings cannot be taken as evidence of a stable association between countries.

Studies on health spending have also produced different results. Wang and Nguyen Thi (2021) examined the causal relationship between health expenditure and income inequality within a quantile panel-type causality framework and reported that the dynamics differ across regimes of the health expenditure-to-income ratio and of income inequality, while Miranda-Lescano et al. (2024) examined the role of social public spending in human development and inequalities. However, differences in the definitions of spending, health care financing arrangements, and estimation methods make it difficult to compare them directly. Total health expenditure and government health expenditure are not the same measure. Furthermore, higher expenditure does not necessarily translate into greater equity in access to healthcare services, particularly when the benefits of service provision and expenditure vary across income groups. These factors are relevant when considering potentially positive expenditure-inequality correlations.

The distributional impact of social protection spending is particularly affected by coverage, targeting, and transfer structure. Popova (2023) found that greater equity in the distribution of social protection spending across income groups is a strong predictor of improved distributional outcomes, while Korpi and Palme (1998) showed that the design of social benefits, in particular targeting versus universal coverage, conditions their redistributive effect. Bação et al. (2025) deployed a dynamic threshold framework to OECD countries and showed that the correlations between social expenditure categories and inequality measures might be different according to economic

conditions. Bastagli et al. (2019) similarly concluded, in their review of cash transfers in low- and middle-income countries, that the effects depend on programme design and implementation features. These results show the role of the structure of the expenditure and institutional frameworks, but differences in statistical significance across models do not imply differences in the size of economic impacts. Moreover, indicators of aggregate social spending cannot independently establish the relationship associated with social protection spending. There are other things to think about like oil dependency and the labor market. Alexeev and Zakharov (2022) found that the growth of oil revenues was associated with increasing inequality in Russian regions. Obama Obama (2026) found that natural resource rents increase income inequality in Sub-Saharan Africa and that social expenditure mitigates this effect, and Mehlum et al. (2006) emphasized that the consequences of resource abundance depend on the quality of institutions. Natural resource rents and government oil revenues are in fact quite different things, and we should not consider their expected relationships with inequality to be directly interchangeable. Asogwa et al. (2022) examined macroeconomic indicators as determinants of income inequality in selected African countries. Likewise, Mocan (1999) linked both structural and cyclical unemployment to income inequality. These studies offer empirical support for the inclusion of oil revenues and unemployment as control variables but do not rule out endogeneity or demonstrate causality.

Iraq-oriented research offers further evidence, but it differs from the present study in its variables and the extent of expenditure consolidation. The current Iraq data do not allow us to conclude conclusively that the separate components of social spending have differential conditional associations with income inequality. Empirical work suggests that the relationship between social spending and inequality depends on the types of spending, institutional contexts, ways of measuring, and econometric models. It cannot be assumed that the findings of educational, health and social welfare research will be homogeneous in an oil-dependent economy like Iraq. Furthermore, caution should be exercised when comparing the results because of the differences between cross-country panel models, threshold specifications and country-specific ARDL approaches. These factors form the empirical base for jointly analyzing the three expenditure items, controlling for oil revenues and unemployment, and differentiating between statistical correlations and causal relationships.

Theoretical Framework

The theoretical background of this paper is based on human capital theory and the redistributive role of fiscal policy to explain the linkages between different components of social expenditure and income inequality. Public expenditure on education, health, and social protection is channeled through different economic channels. Oil revenues and unemployment are key fiscal and labor market conditions in Iraq. The Gini coefficient as an indicator of income inequality is used to analyze those associations.

Education Investment and Income Inequality

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The human capital theory Becker (1962) provides a basis for understanding the relationships between education investment and the income gap. Public investment in education could enhance access to information and skills, improve the efficiency of the workforce, and raise future income prospects. Education spending can redistribute educational resources, especially to low-income families, and can reduce differences in earning potential. However, its distributional implications depend on the availability of educational services, the effectiveness of spending, and the distribution of the educational benefits across income classes (De Gregorio & Lee, 2002; Voto & Ngepah, 2024). Hence, in theory, a negative association between education expenditure and the Gini coefficient is anticipated, although this relationship may not be consistent across various economic contexts.

Health Expenditure and Income Inequality

Changes in health-related human capital, labour productivity, and household economic circumstances may link public health expenditure to income inequality. Publicly funded health care can alleviate the economic burden of illness, especially for low-income families, and promote engagement in beneficial activities. However, the distributional effects of health spending depend on the availability, quality and distribution of health services (Mathai et al., 2020; Wang & Nguyen Thi, 2021). Public health spending may increase alongside greater income inequality if more advantaged groups primarily capture its benefits. Thus, this paper establishes that health expenditure has no clear theoretical relationship with the Gini coefficient, and the direction of this relationship is ambiguous.

Social Protection Expenditure and Income Inequality

Income inequality is related to the redistributive function of fiscal policy through social protection spending. Transfers, benefits and social aid can increase household disposable income and lower the vulnerability to income reductions. Social protection spending can help promote a more equitable income distribution, especially when benefits are well targeted to low income groups. Its impact depends however on the programme's coverage, eligibility rules, targeting and the modality of benefit delivery (Bastagli et al., 2019; Korpi & Palme, 1998; Popova, 2023). Hence, a negative correlation between social protection spending and the Gini coefficient is theoretically expected. However, the size of expenditure itself cannot be used to gauge the effectiveness of redistribution.

Oil Revenues and Income Inequality

Oil revenues are a key fiscal variable in Iraq, since they determine the amount of resources available to finance government expenditures. Higher oil revenues could improve fiscal capabilities and facilitate delivery of public services and social initiatives. Alternatively, differences in access to economic benefits related to oil and differences in revenue distribution may be associated with rising income inequality (Alexeev & Zakharov, 2022; Obama Obama, 2026). Therefore, the destiny of this

relationship relies on the allocation and organization of the budget. Oil revenues are included as a control variable to account for fiscal fluctuations, without assuming a priori that they have a positive or negative relationship with the Gini coefficient.

Unemployment and Income Inequality

Differences in access to labor earnings primarily drive the correlation between income disparity and unemployment. Higher unemployment can cause lower household income and greater income inequality, especially when social safety nets are not sufficient to compensate for lost income (Mocan, 1999). However, the correlation may differ depending on labor market conditions and the distribution of unemployment across income groups. Therefore, we would expect to see a theoretical correlation between unemployment and the Gini coefficient. The unemployment rate is included as a control variable to account for the labor market situation and to analyze the relationships between the components of social expenditure and income disparity.

Taken collectively, these theories imply that education and social protection may be negatively related to income inequality, whereas the relationship with health expenditure is unclear. Oil revenues and unemployment are included to capture relevant fiscal and labor market conditions. The framework provides the theoretical foundation for the research hypotheses and the conceptual model, which are presented in the following sections. These mechanisms are not directly quantified in the econometric model. Rather, it estimates conditional associations rather than causal pathways.

Research Hypotheses

The study uses empirical research and theoretical constructs to propose three hypotheses on the relationship between elements of social expenditure and income disparity in Iraq. The conjectures indicate that the mechanisms for allocating expenditures on education, health, and social protection are different, in particular, in terms of access to public services, distribution of expenditure, and distribution of benefits between income classes (Anderson et al., 2017; Korpi & Palme, 1998; Mathai et al., 2020; Popova, 2023).

H1: *There is a negative relationship between financial investment in education and income inequality in Iraq.*
H2: *The relationship between health expenditure and income inequality in Iraq is examined.*
H3: *In Iraq, social protection spending is negatively correlated with income inequality.*

The hypotheses are tested, taking into account oil revenues and unemployment. These variables reflect relevant financial and labor market conditions but are not proposed as separate hypotheses of research.

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Conceptual Framework

The research is based on the theoretical framework summarized in Figure 1. The independent variables are expenditure on education (X1), health (X2), and social protection (X3), and the dependent variable is income inequality measured by the Gini coefficient (Y). The control variables are oil revenues (Z1) and the unemployment rate (Z2), which reflect the financial and employment circumstances in Iraq. The framework describes the hypothesized relationships between components of social expenditure and income inequality and should not be interpreted as showing evidence of causal relationships.

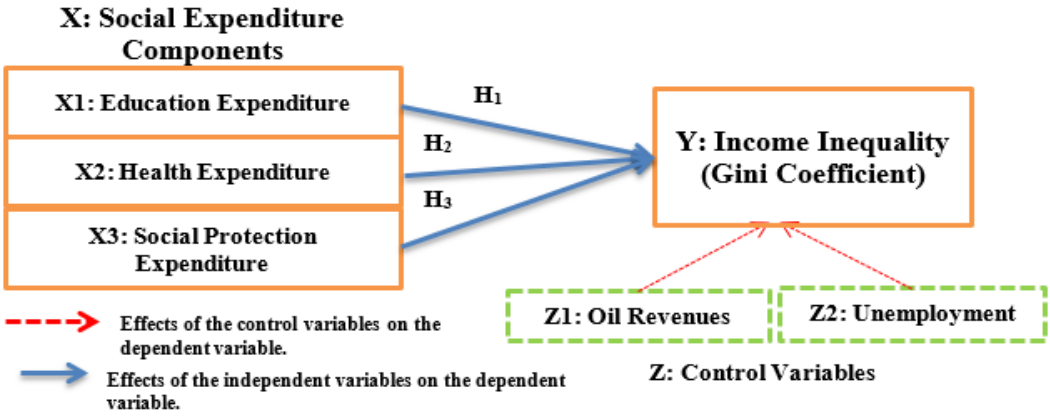

Figure 1: Hypothesized Research Model
Note: Authors' conceptualization based on the theoretical framework and research hypotheses.

RESEARCH METHODOLOGY

The study follows a quantitative econometric approach to examine the relationship between the components of social expenditure and income inequality in Iraq for the period 2004-2025. The test uses 22 years of data for each variable from the Iraqi Ministry of Finance and the Central Bank of Iraq. The Gini coefficient (Y), a widely used summary measure of income inequality (Solt, 2020), is the dependent variable. The independent variables are expenditure on education (X1), health (X2), and social protection (X3), all in percentage of gross domestic product (GDP). Oil revenues (Z1), measured as a share of GDP, and the unemployment rate (Z2), expressed as a percentage, are introduced as control variables. The theoretical framework predicts a negative relationship between education and social protection expenditures and inequality, while health expenditures and oil revenues may have either a positive or a negative relationship. Unemployment is expected to move in a positive direction. Table 1 lists the variables, their metrics, and expected indicators.

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Table 1: Description of Model Variables and Expected Signs

Variable Category	Indicator	Symbol	Expected Sign
Independent Variable (X)	Education expenditure (% of GDP)	X1	−
	Health expenditure (% of GDP)	X2	+/−
	Social protection expenditure (% of GDP)	X3	−
Dependent Variable (Y)	Gini coefficient	Y	—
Control Variables (Z)	Oil revenues (% of GDP)	Z1	+/−
	Unemployment rate (%)	Z2	+

Note: X1–X3 = independent variables; Y = dependent variable; Z1–Z2 = control variables; − = expected negative sign; + = expected positive sign; +/− = ambiguous expected sign.

The Boot–Feibes–Lisman (BFL) technique is used to temporally disaggregate the annual data to projected quarterly series (Boot et al., 1967). Quarterly data are not consistently available for all variables, and temporal disaggregation is a standard procedure in such cases (Chow & Lin, 1971). The method yields smooth quarterly paths by minimizing the sum of squared deviations between consecutive estimated observations:

$$\min \ \Sigma_{(q=2)}^{4T} (\hat{X}q - \hat{X}q_{-1})^2$$

subject to the annual-average preservation constraint:

$$\frac{1}{4}\Sigma_{j=1}^{4}\hat{X}_{t,j} = X_t$$

where $\hat{X}_q$ represents an estimated quarterly observation, (T) denotes the number of years, X_t is the original annual value, and $X_{t,j}$ is the estimated observation for quarter (j) of year (t). For ratios and rates, the constraint preserves the annual observation as the arithmetic average of its estimated quarterly values without implying an accounting identity between annual ratios and observed quarterly ratios. The procedure produces 88 estimated quarterly observations covering 2004Q1–2025Q4. These observations are not directly observed, but are constructed and do not provide any additional independent economic data beyond the first 22 annual observations. Thus, temporal smoothing can affect the estimated persistence, lag specifications and statistical significance, prompting a cautious interpretation of the econometric findings.

The econometric specification of the relation between income inequality, the components of social expenditure and the control variables is given as:

$$Y_t = \beta_0 + \beta_1 X1_t + \beta_2 X2_t + \beta_3 X3_t + \beta_4 Z1_t + \beta_5 Z2_t + \varepsilon_t$$

where β_0 is the intercept, β_1–β_2 are regression coefficients, and ε_t is the stochastic error term. The coefficients represent conditional statistical associations rather than causal

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effects.

To test the stationarity properties of the variables, we use the Phillips-Perron (PP) unit-root test (Phillips & Perron, 1988). The results suggest that Y, X1, X2, X3, and Z1 are integrated of order one, I(1), while Z2 is integrated of order zero, I(0). No variables are integrated of order two, I(2). Therefore, the Autoregressive Distributed Lag (ARDL) bounds-testing method is employed to examine the presence of a long-run equilibrium relation among the variables (Pesaran et al., 2001).

The unrestricted error correction model (UECM) for the selected ARDL(6,3,1,0,5,2) lag order is specified as follows:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{5} \phi_i \, \Delta Y_{t-i} + \sum_{j=0}^{2} \theta_{1j} \, \Delta X1_{t-j} + \theta_{20} \Delta X2_t + \sum_{j=0}^{4} \theta_{4j} \, \Delta Z1_{t-j} + \sum_{j=0}^{1} \theta_{5j} \, \Delta Z2_{t-j} + \lambda_1 Y_{t-1} + \lambda_2 X1_{t-1} + \lambda_3 X2_{t-1} + \lambda_4 X3_t + \lambda_5 Z1_{t-1} + \lambda_6 Z2_{t-1} + \varepsilon_t$$

where Δ denotes the first-difference operator, φ_i and θ_{kj} represent short-run coefficients, and λ_1–λ_6 denote the coefficients of the level variables. The contemporaneous level of X3 reflects its zero-lag specification. The intercept is represented by α_0, and ε_t denotes the stochastic error term.

The existence of a long-run levels relationship is examined using the following hypotheses:

$$H_0: \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = 0$$

H_1: At least one $\lambda_i \neq 0$

The estimation results in EViews indicate that the bounds test is conducted under Case 2 (restricted constant and no trend). The F-statistic is compared with the appropriate lower I(0) and the upper I(1) critical bounds. The lag structure is selected according to the Akaike Information Criterion (AIC; (Akaike, 1974)), and it turns out to be ARDL(6,3,1,0,5,2). The critical values for the bounds test are asymptotic (Pesaran et al., 2001), so careful decisions should be made due to the limited amount of original yearly data; finite-sample critical values for small samples are generally larger than the asymptotic ones (Kripfganz & Schneider, 2020; Narayan, 2005).

When a cointegration relationship is found, long-term coefficients and an error correction model are estimated to study the equilibrium relationships and short-term adjustments. The error correction coefficient measures changes in the temporally disaggregated model rather than changes in the quarterly economic variable observed separately. The model adequacy is checked by the Breusch–Godfrey LM test for serial correlation in residuals (Breusch, 1978; Godfrey, 1978), the ARCH test for conditional heteroscedasticity (Engle, 1982), the Ramsey RESET test for functional-form mis-

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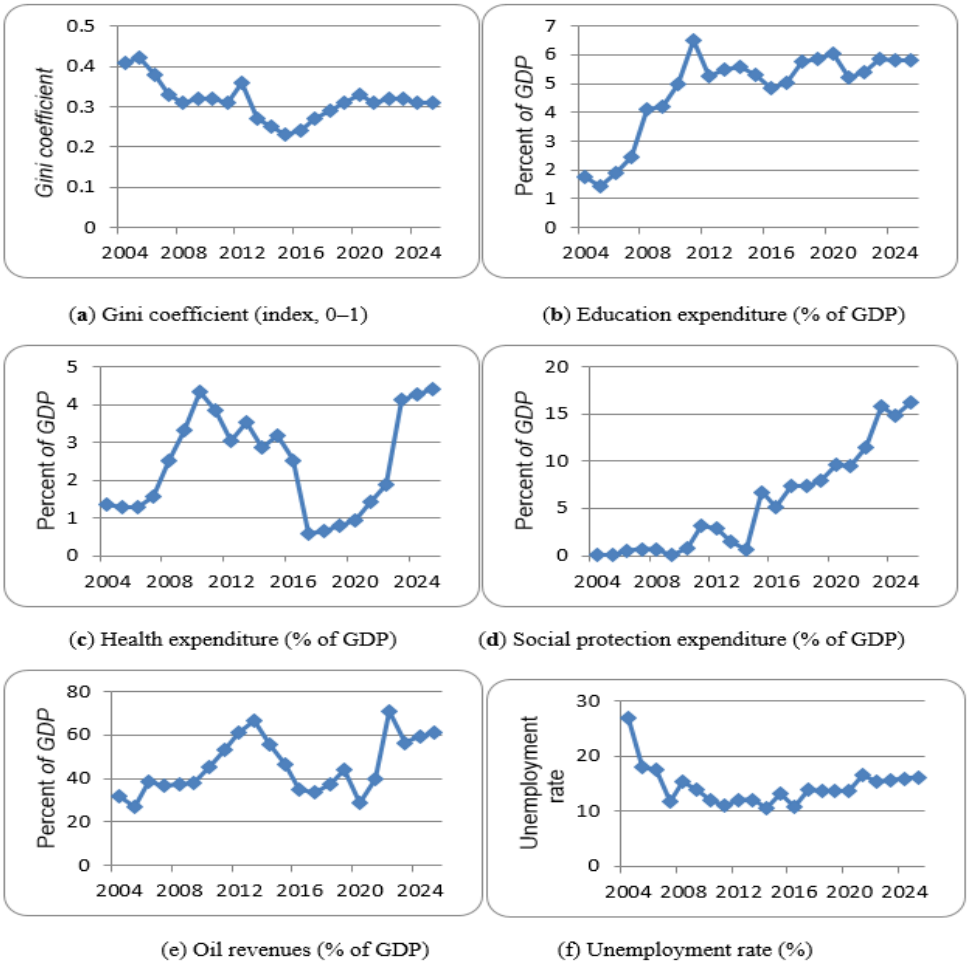
specification (Ramsey, 1969), and the Jarque–Bera test for normality of residuals (Jarque & Bera, 1987).

The Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) tests are used to test for stability of parameters. Diagnostic evidence is considered collectively, and no single test result is considered conclusive to establish the overall adequacy or stability of the model. All the econometric analyzes were done with the software EViews 10. The level of statistical significance was mostly at 5%.

RESULTS AND DISCUSSION

Figure 2 shows the annual trends of income inequality, components of social spending, oil revenue, and unemployment rates in Iraq from 2004 to 2025.



(a) Gini coefficient (index, 0–1)
(b) Education expenditure (% of GDP)
(c) Health expenditure (% of GDP)
(d) Social protection expenditure (% of GDP)
(e) Oil revenues (% of GDP)
(f) Unemployment rate (%)

Figure 2: Annual Trends in the Study Variables in Iraq, 2004–2025
Note: Compiled by the researcher using data from the Central Bank of Iraq and the Iraqi Ministry of Finance.

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The Gini coefficient was 0.41 in 2004, 0.23 in 2015, and 0.31 in 2025, indicating changes in the income distribution during the period studied. Spending on education grew from 1.77% of GDP to 5.83% of GDP, and spending on health and social protection varied widely. Expenditure on social protection ranged from 0.07% of GDP in 2012 to 16.24% in 2022. Oil revenues were volatile, ranging from 27.01% of GDP in 2005 to 71.19% in 2022, demonstrating Iraq's dependence on oil-based financial resources. The unemployment rate also decreased from 26.80% in 2004 to 16.17% in 2025. These developments highlight the need to take into account social expenditure and income inequality when considering Iraq's oil-dependent economic and labor-market environments.

Table 2 presents the results of the Phillips–Perron (PP) unit-root test. It is noted that the Gini coefficient, educational spending, healthcare spending, social protection spending, and oil revenues are non-stationary at the levels, but they become stationary after the first differencing. But unemployment is still the same on some levels. Hence, the variables are a combination of I(0) and I(1) variables with no evidence of the existence of I(2) variables. The results satisfy the integration-order requirement for the application of the ARDL bounds-testing approach, although they capture the properties of temporally disaggregated data rather than directly observed quarterly data.

Table 2: Phillips–Perron Unit-Root Test Results

Variable	I(0): Intercept	I(0): Intercept and Trend	I(0): None	I(1): Intercept	I(1): Intercept and Trend	I(1): None	Order of Integration
Y	0.3048	0.7567	0.3354	0.0001***	0.0003***	0.0000***	I(1)
X1	0.4302	0.8011	0.8482	0.0000***	0.0003***	0.0000***	I(1)
X2	0.6389	0.8694	0.7002	0.0004***	0.0028***	0.0000***	I(1)
X3	0.981	0.4461	0.977	0.0000***	0.0001***	0.0000***	I(1)
Z1	0.3557	0.4895	0.6659	0.0000***	0.0004***	0.0000***	I(1)
Z2	0.0000***	0.0000***	0.0208**	—	—	—	I(0)

Note: Values represent PP test p-values. *** and ** indicate significance at the 1% and 5% levels, respectively.

The Akaike Information Criterion (AIC) showed that the ARDL(6,3,1,0,5,2) model was the best among the models investigated (Figure 3). The selected lag configuration allows for different dynamic reactions among the explanatory variables. However, the relatively wide lag structure must be interpreted with caution because the 88 estimated quarterly data points are based on only 22 annual observations.

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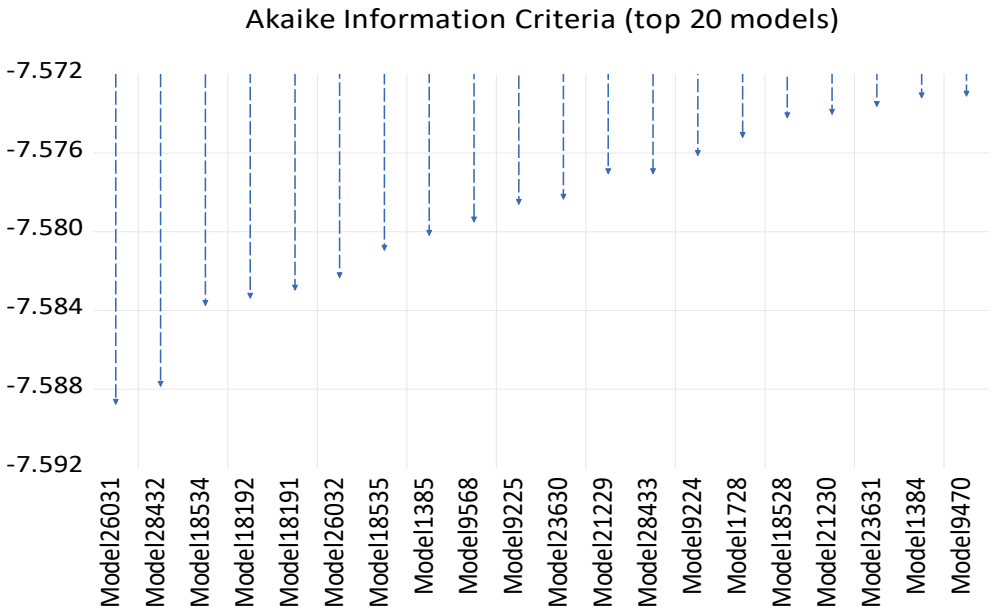

Figure 3: Selection of the ARDL Model Based on the Akaike Information Criterion
Note: Output generated by the authors using EViews 10. The ARDL(6,3,1,0,5,2) specification is the model selected by the Akaike information criterion.

The ARDL bounds test results reveal that the F-statistic value of 4.594307 exceeds the reported upper bound critical value of 4.15 at the 1% significance level (Table 3). In Case 2 (restricted constant, no trend), the result implies the rejection of the null hypothesis of no level relationship with the asymptotic critical values as supplied (Pesaran et al., 2001). However, since the quarterly data are obtained from temporal disaggregation, the statistical results should not be interpreted as if they were based on 88 quarterly observations collected independently. Finite-sample critical values for small samples (Narayan, 2005) are larger than the asymptotic values reported in Table 3, which is a further reason for cautious interpretation.

Table 3: ARDL Bounds Test Results

Test Statistic	**Value**	
F-statistic	4.594307	
Number of regressors (k)	5	
Significance Level	Lower Bound I(0)	Upper Bound I(1)
10%	2.08	3
5%	2.39	3.38
2.50%	2.7	3.73
1%	3.06	4.15

Note: Case 2 (restricted constant and no trend). The reported critical values are asymptotic.

Table 4 shows the projections of long-term coefficients. Health expenditure (X2) has a positive and statistically significant association with the Gini coefficient (β=0.025387,

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p=0.0396). This result contradicts the standard assumption that public health expenditures are inequality-reducing. In Iraq, the positive association might be due to differences in the availability of public health services, the way spending is allocated, or the way health care benefits are distributed. But these explanations do seem like possible interpretations, not mechanisms demonstrated by the model being assessed.

Table 4: Estimated Long-Run Coefficients

Variable	Coefficient	Standard Error	t-statistic	p-value
X1	0.000433	0.014214	0.030471	0.9758
X2	0.025387	0.012064	2.104454	0.0396
X3	0.004058	0.003882	1.045243	0.3002
Z1	−0.005588	0.002594	−2.154440	0.0353
Z2	0.003437	0.008511	0.403843	0.6878
C	0.420308	0.17339	2.424056	0.0184

Note: X1 = education expenditure; X2 = health expenditure; X3 = social protection expenditure; Z1 = oil revenues; Z2 = unemployment rate; C = constant. The dependent variable is the Gini coefficient (Y).

Oil revenues (Z1) have a negative and statistically significant long-run relation with inequality ($\beta = -0.005588$, $p = 0.0353$). This is consistent with the view that the financial resources generated by oil permit redistribution through public expenditure, transfers, and government-related revenue. However, the model does not show that these channels are directly responsible for the observed correlation. The organization is also contingent on the wider institutional and financial context that shapes the distribution of oil revenues.

There is no long-term statistical significance of the expenditure on education (X1), social protection (X3), and unemployment (Z2). The small coefficients imply not the absence of economic relationships but the lack of statistical evidence in the model we estimate for the persistence of long-term relationships for these variables. The redistributive impact of education and social protection spending may be dependent on the effectiveness of expenditure, the targeting strategies, and the distribution of benefits, which are not explicitly captured in the current framework.

The long-term projections in Table 4 show that health expenditure (X2) has a positive and statistically significant relationship with the Gini coefficient ($\beta = 0.025387$, $p = 0.0396$), while education expenditure (X1) and social protection expenditure (X3) are not statistically significant. This contrasts with the finding of Sylwester (2002) that higher public education expenditure is associated with lower income inequality. Voto and Ngepah (2024), using fully modified ordinary least squares for sub-Saharan African countries, found that public education expenditure increased income inequality in the long run while its squared term reduced it, and Bação et al. (2025) reported a positive contribution of old-age pensions to the Gini index in OECD countries. The differences indicate that the relations between social expenditure and inequality differ across national contexts, expenditure categories, and model specifications. These differences may be explained by the pattern of expenditures, public services, and distribution of benefits in Iraq. However, the current model does not explicitly test these mechanisms.

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Oil revenues (Z1) are statistically significant negative determinants of inequality in the long run (β = −0.005588, p = 0.0353). This result is consistent with the negative association for some clusters of countries found by Sawadogo and Ouoba (2024) in their study of 73 developing countries using finite-mixture regression. They found that natural resource rents were associated with increased inequality in two regimes, decreased inequality in another two regimes, and no statistically significant association for the fifth. Their research suggests that the relationship between resources and inequality is mixed and not necessarily redistributive. Obama Obama (2026), by contrast, found that natural resource rents increase income inequality in Sub-Saharan Africa, and Alexeev and Zakharov (2022) found that oil windfalls increased inequality in Russian regions with more intense rent-seeking. However, their measure of natural resource rents is not the same as the oil-revenue measure used in this study. Thus, the coefficients are not directly comparable.

Unemployment (Z2) has an insignificant long-run coefficient (p = 0.6878) against the link between unemployment and income inequality documented by Mocan (1999) for the United States. This difference can be because of different national coverage, model configuration and data features. The small coefficients on education, social protection and unemployment do not indicate that these variables are not distributionally significant, but rather that there is no strong statistical evidence of long-lasting relationships in the estimated Iraqi model.

Table 5: Estimated Short-Run Dynamics and Error Correction Coefficient

Variable	Coefficient	Standard Error	t-statistic	p-value
ΔY(−1)	0.514862	0.089544	5.749838	0
ΔY(−2)	0.146131	0.07733	1.889712	0.0637
ΔY(−3)	0.071595	0.069325	1.032743	0.3059
ΔY(−4)	−0.565516	0.078911	−7.166490	0
ΔY(−5)	0.327314	0.077475	4.224778	0.0001
ΔX1	−0.020012	0.002797	−7.155820	0
ΔX1(−1)	0.010329	0.003451	2.993277	0.004
ΔX1(−2)	0.003853	0.003087	1.248267	0.2169
ΔX2	−0.003130	0.002496	−1.254050	0.2148
ΔZ1	−0.000295	0.000192	−1.532160	0.1308
ΔZ1(−1)	0.000474	0.000198	2.400423	0.0195
ΔZ1(−2)	0.000271	0.000199	1.356781	0.18
ΔZ1(−3)	0.000245	0.0002	1.22312	0.2261
ΔZ1(−4)	0.000854	0.000236	3.611555	0.0006
ΔZ2	0.002833	0.000743	3.813647	0.0003
ΔZ2(−1)	−0.001480	0.000691	−2.140880	0.0364
ECT(−1)	−0.071620	0.012032	−5.952370	0

Note: The dependent variable is ΔY. Δ = first-difference operator; X1 = education expenditure; X2 = health expenditure; Z1 = oil revenues; Z2 = unemployment rate; ECT(−1) = error correction term lagged one period.

In Table 5, the short-term forecasts with varying dynamic relationships are presented. The coefficient of education expenditure is negative in the current period (−0.020012,

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$p < 0.01$) and positive in the first lag (0.010329, $p = 0.0040$). The coefficient of contemporaneous health expenditure is not statistically significant. These results differ in time horizon and evaluation framework from those of Voto and Ngepah (2024), who estimated long-run effects of public education expenditure on income inequality in a panel of sub-Saharan African countries. Therefore, their results should not be considered definitive proof of the quarterly lag effects taken into account for Iraq.

Oil revenues have positive and statistically significant coefficients in the first and fourth lags but a negative long-run coefficient. This variation is in agreement with the larger diversity reported by Sawadogo and Ouoba (2024) but their study does not describe the specific short-term dynamics found here. Unemployment is positively associated with current inequality (0.002833, $p = 0.0003$), in line with the unemployment–inequality link documented by Mocan (1999), but the negative first-lag coefficient (−0.001480, $p = 0.0364$) indicates that the estimated relationship is time-varying. The documented ECM has no specific differenced coefficient for social protection expenditure, as the selected ARDL lag order is zero.

The coefficient of the error correction term is negative and statistically significant (ECT = −0.071620, $p < 0.01$), indicating a correction process toward the projected long-run relationship at approximately 7.16% per constructed quarter. Since the quarterly series are based on 22 annual observations, the short-run dynamics and the significance they imply should be interpreted with caution and not as independent quarterly observations.

Table 6: Diagnostic Test Results

Test	Statistic	Value	Degrees of Freedom	p-value
Breusch–Godfrey LM	F-statistic	1.78247	F(2,57)	0.1775
	Obs × R^2	4.82664	$\chi^2(2)$	0.0895
ARCH	F-statistic	0.004337	F(1,79)	0.9477
	Obs × R^2	0.004447	$\chi^2(1)$	0.9468
Ramsey RESET	F-statistic	0.113589	F(1,58)	0.7373
	Likelihood Ratio	0.160434	1	0.6888
Jarque–Bera	JB statistic	27.29576	—	0.000001

Note: LM = Lagrange multiplier; ARCH = autoregressive conditional heteroskedasticity; RESET = regression specification error test; Obs × R^2 = observations multiplied by R-squared.

The model is an excellent fit to the sample (adjusted R2 = 0.985389) but this does not, in isolation, validate the statistical inference. The diagnostic tests reported in Table 6 provide no statistically significant evidence of serial correlation, ARCH-type heteroskedasticity or functional form misspecification at the 5% significance level. However, the Jarque–Bera test does not accept the null hypothesis that the residuals are normally distributed (JB = 27.295760, $p = 0.000001$). The residuals distribution is presented in Figure 4. It is negatively skewed with a kurtosis higher than the kurtosis of a normal distribution. This finding calls for caution in the interpretation of traditional

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statistical significance, particularly given the temporally fragmented nature of the quarterly data.

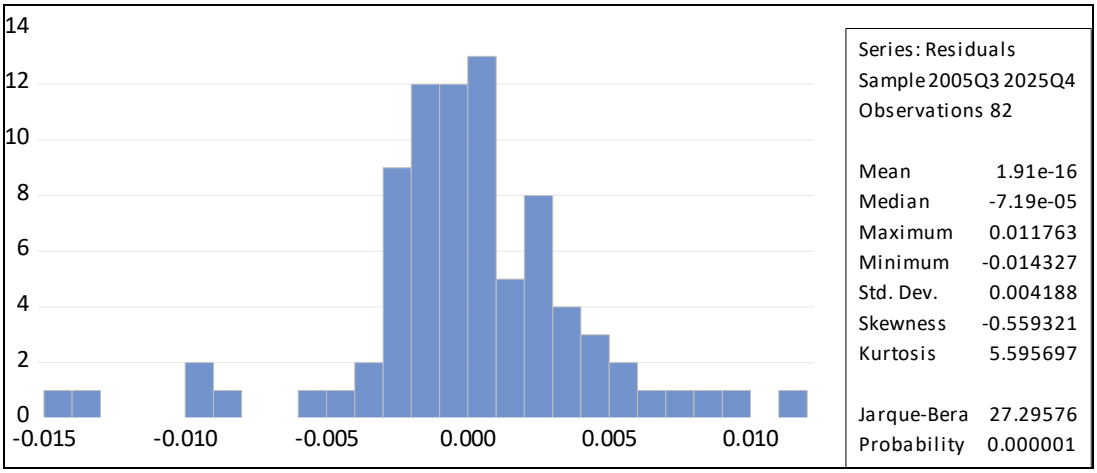

Figure 4: Residual Distribution and Jarque–Bera Normality Test
Note: Output generated by the authors using EViews 10.

As shown in Figure 5, the stability tests of the parameters are inconclusive. The CUSUM statistic is within the 5% critical thresholds, while the CUSUMSQ statistic goes beyond the critical thresholds for a moment, then returns to the critical thresholds.

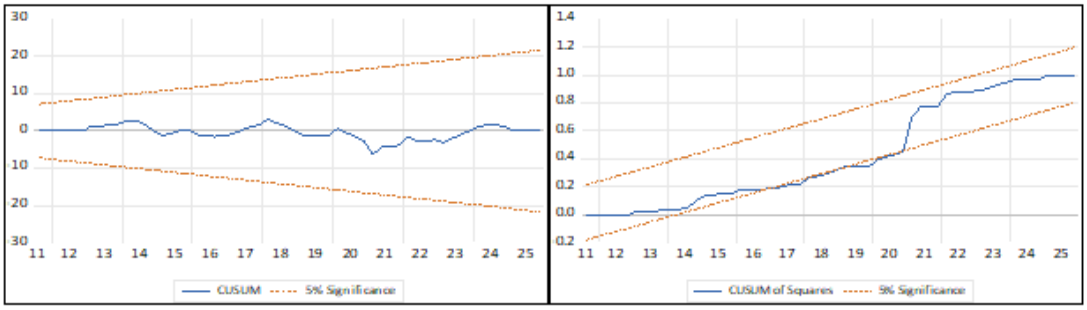

Figure 5: CUSUM and CUSUMSQ Parameter Stability Tests
Note: Output generated by the authors using EViews 10. The CUSUM and CUSUMSQ statistics are assessed against the 5% critical bounds.

This divergence is an indication that some parameters are unstable at some point in the study period, and a definite conclusion on model stability is precluded. Due to the residual non-normality and the temporal disaggregation of annual data, the estimated relationships have to be interpreted with care.

The results suggest differences in the projected long-run relationships across the components of social spending. The positive coefficient for health expenditure is contrary to the expected redistributive role of public services, while the negative oil-

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revenue coefficient points to a potentially significant relationship between fiscal resources and income distribution in Iraq. The small coefficients of educational and social protection spending suggest that the magnitude of expenditure does not per se bring about measurable reductions in inequality.

The results should be interpreted in light of the methodological limitations of the study. The conversion from annual to quarterly data increases the number of observations estimated without adding any new underlying independent economic information. Moreover, the residual non-normality and the temporary crossing of the CUSUMSQ threshold, weaken the basis for strong inferential statements. Therefore, the results only tentatively support statistical associations in the specified ARDL model and not as conclusive evidence of causal or structurally consistent associations.

CONCLUSION

This study examines the association between education, health and social protection expenditures and income inequality in Iraq for the period 2004-2025, taking into account oil revenues and unemployment rates. The results suggest that projected long-term relationships differ among components of social expenditure, thus indicating the need to analyze these categories separately, instead of treating social expenditure as a whole.

The long-run correlation between the Gini coefficient and expenditures on education and social protection is statistically insignificant, implying that the initial and tertiary research hypotheses have not been empirically validated. Conversely, health expenditure is characterized by a positive and statistically significant long-term correlation supporting the second hypothesis on the existence of a relationship, but with a positive orientation. Among the control variables, oil revenues are negatively and significantly correlated with inequality, and unemployment is statistically insignificant in the long run. These results indicate that higher social spending ratios do not necessarily relate to lower income inequality and that the relationships analyzed differ between expenditure categories.

The results are important for the assessment of public expenditure in Iraq. Education, health, and social welfare programs should be evaluated not merely on the basis of budgets but on such factors as accessibility of services, cost-effectiveness, reach, and equitable distribution of benefits across income groups. In particular, the analysis of the distribution of health expenditures and the orientation of social protection programs should be enhanced. In addition, Iraq's heavy dependence on oil revenues indicates the importance of sustainable financing of social programs and the need to consider income distribution in the assessment of fiscal policies. These suggestions are within the scope of policy evaluation domains and not within the scope of causal relationships derived from econometric results.

Major methodological shortcomings limit the results. The series on a quarterly basis was obtained by the temporal disaggregation of 22 annual data points, which do not provide any additional independent economic information. So caution should be exercised in interpreting the projected short-term dynamics and the traditional statistical significance. In addition, the presence of persistent non-normality along with occasional violation of the CUSUMSQ critical values poses problems for statistical inference and parameter stability. The results are therefore to be interpreted as conditional statistical correlations in the ARDL setting specified rather than as definitive evidence of causal relationships.

Further research based on direct observations of high-frequency data and more detailed information on expenditures or distribution measures at the household level may further clarify the relationship between social spending and oil-dependent public finances and income inequality in Iraq.

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DATA AVAILABILITY STATEMENT

The data used in this study are publicly available from the Central Bank of Iraq, and the Iraqi Ministry of Finance.

CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

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