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Fiscal Discipline Indicators and Variables of Kaldor Magic Square: Evidence from Iraq

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Abstract

Fiscal discipline is a foundational determinant of macroeconomic stability, shaping a government's capacity to manage public resources efficiently, contain deficits, and constrain the accumulation of public debt. This study assesses the impact of fiscal-discipline indicators—revenue-to-GDP, expenditure-to-GDP, and the fiscal balance-to-GDP—on the variables of Kaldor Magic Square (growth, inflation, unemployment, and external balance) in Iraq for the period 2004–2023. Using Ordinary Least Squares (OLS) regression on a constructed Kaldor composite index, the model explains 72% of the variation in the composite (R^2 = 0.72; Durbin–Watson = 1.925; F-probability = 0.0019). The findings show that, although the relationships are statistically significant, Iraq's heavy reliance on oil revenues, recurrent operational spending, and weak fiscal rules limit the ability of fiscal discipline to deliver the targeted state of Kaldor Magic Square. The paper recommends rule-based fiscal frameworks, revenue diversification, and investment-oriented public expenditure as prerequisites for macroeconomic stability.

Keywords: Fiscal discipline, Kaldor's Magic Square, economic growth, inflation stability, Iraqi economy.

JEL Classification: D0 , A1

1. Introduction

Maintaining macroeconomic stability has become a central objective of public policy in developing and resource-dependent economies, where shocks to commodity prices propagate rapidly to the fiscal balance, the labor market, and the price level (IMF, 2023; World Bank, 2022). Fiscal discipline—understood as a credible commitment by government to align expenditure with sustainable revenues and to constrain deficits and debt within prudential limits—is widely

recognized as the institutional foundation that enables monetary, exchange-rate, and structural policies to operate effectively (Alesina & Perotti, 1996; Wyplosz, 2013).

In Iraq, this challenge is particularly acute. The economy remains structurally dependent on oil revenues, which have historically accounted for more than 90% of total public revenues and the bulk of foreign-exchange earnings (Central Bank of Iraq, 2023). This rentier structure exposes the fiscal accounts to sharp cyclical fluctuations and has, over the period 2004–2023, produced repeated episodes of deficit, debt accumulation, and procyclical expenditure—most visibly during the 2014 oil-price collapse, the 2014–2015 security shock, and the COVID-19 crisis of 2020 (Khaleel, 2024; Aljebory et al., 2025). Kaldor (1971) proposed the so-called Magic Square as a compact diagnostic of macroeconomic performance, jointly tracking four ultimate objectives: a high rate of real GDP growth, full employment, price stability, and external balance. The geometric expansion of the square is interpreted as a measure of the overall effectiveness of economic policy. A growing literature applies the Kaldor framework to oil-exporting and transition economies to assess whether fiscal frameworks succeed in delivering balanced macroeconomic outcomes (Mohammed & Bahjat, 2019; Sokolov & Matveev, 2024). Problem statement. Despite two decades of reconstruction, reform programs, and rising oil revenues, the Iraqi economy continues to exhibit weak compliance with fiscal rules, a rigid operational expenditure structure, persistent unemployment, and recurring inflationary pressures. The central problem addressed in this paper is therefore: To what extent are fiscal-discipline indicators (revenue/GDP, expenditure/GDP, fiscal balance/GDP) capable of moving the variables of Kaldor Magic Square toward their target values in Iraq during 2004–2023? Existing studies on Iraq have examined fiscal discipline and individual macroeconomic outcomes in isolation (Hussain et al., 2023; Tomas, 2025; Ali et al., 2025), but none has tested the joint impact of fiscal-discipline indicators on a composite Kaldor index for the full post-2003 period.

Objectives. The study (i) measures the evolution of fiscal-discipline indicators in Iraq for 2004–2023; (ii) constructs a Kaldor composite index from growth, inflation, unemployment, and external-balance data; and (iii) estimates the impact of fiscal-discipline indicators on this composite using OLS regression.

Hypothesis. Adherence to fiscal-discipline rules has a positive and statistically significant effect on the Kaldor Magic Square variables in Iraq, but the magnitude of this effect is constrained by oil dependence and the dominance of operational expenditure.

Contribution. The paper contributes to the literature on rentier-state fiscal policy by providing the first integrated econometric assessment of fiscal-discipline indicators on Kaldor Magic Square variables for Iraq, and by linking the empirical results to a social-impact discussion relevant for policymakers.

2. Literature Review

The literature on fiscal discipline has evolved from rule-based prescriptions for advanced economies (Alesina & Perotti, 1996; Wyplosz, 2013) toward institutional analyses of resource-rich and emerging economies, where fiscal volatility is the dominant macroeconomic concern (Frankel, 2011; IMF, 2023). Three strands are directly relevant to this study.

First, the macroeconomic effects of fiscal discipline. El-Shagi (2011) demonstrates that fixed exchange-rate regimes can act as substitutes for explicit fiscal rules, while Sokolov and Matveev (2024) show, for a panel of emerging economies, that the credibility of fiscal discipline raises growth by 0.4–0.7 percentage points per year. Bergman and Hutchison (2020) and Larch et al. (2021) find that numerical fiscal rules reduce deficit bias when they are accompanied by independent fiscal councils.

Second, the Kaldor Magic Square framework. Originating in Kaldor (1971), the framework has been applied to advanced economies (Drastichová, 2012), Gulf and oil-exporting economies (Mohammed & Bahjat, 2019), and the European Union (Ünal, 2018). These studies converge on the finding that fiscal expansion in resource-dependent economies tends to improve growth and employment in the short run, but at the cost of inflation and external imbalances in the medium run. Third, fiscal policy and macroeconomic outcomes in Iraq. Khaleel (2024) finds a positive but weak elasticity of agricultural growth to fiscal expansion; Hussain et al. (2023) attribute Iraq's persistent fiscal deficits to misallocation of expenditure rather than insufficient revenues; Aljebory et al. (2025) document the procyclical nature of the Iraqi budget; Tomas (2025) shows that exchange-rate stability has substituted for weak fiscal rules; Ali et al. (2025) report that monetary and fiscal variables jointly explain less than half of the variation in inflation and unemployment, pointing to a structural gap. Research gap. While each of these strands is well developed, no study has (a) constructed a Kaldor composite index for Iraq for the full 2004–2023 period, or (b) estimated the joint impact of the three core fiscal-discipline ratios on this composite. This paper closes that gap and complements the largely descriptive Iraqi literature with an explicit econometric test.

3. Data and Methodology

3.1 Data

The study uses annual data for Iraq from 2004 to 2023, drawn from the Central Bank of Iraq Annual Bulletins, the Iraqi Ministry of Finance, the Ministry of Planning – Central Statistical Organization, the World Bank World Development Indicators, and the IMF Article IV consultations. Three fiscal-discipline ratios are computed (revenue/GDP, expenditure/GDP, fiscal balance/GDP); four macroeconomic indicators feed the Kaldor composite (real GDP growth, inflation, unemployment, and external balance / GDP).

3.2 Construction of the Kaldor composite (W)

Following Kaldor (1971) and Mohammed and Bahjat (2019), each of the four Magic Square variables is rescaled to a 0–100 score relative to its target value (growth ≥ 6%, inflation ≤ 3%, unemployment ≤ 5%, external balance ≥ 2%). The composite W is the simple arithmetic mean of the four scaled scores; higher values indicate a more expanded—hence more 'magic'—square.

3.3 Empirical model

The relationship between fiscal-discipline indicators and the Kaldor composite is estimated using Ordinary Least Squares (OLS):

$$W = \beta 0 + \beta 1 \cdot R + \beta 2 \cdot T + \beta 3 \cdot S + \varepsilon$$

where W is the Kaldor composite, R is revenue / GDP, T is expenditure / GDP, S is the fiscal balance / GDP, and ε is the random error. The specification is supported by a battery of diagnostics: an Augmented Dickey–Fuller (ADF) unit-root test on each series, a Breusch–Pagan test for

heteroscedasticity, a Durbin–Watson test for serial correlation, and the F-test for overall significance. The model is estimated in EViews 12.

2. Results and Discussion

4.1 Fiscal-discipline indicators in Iraq

Table 1 reports the three fiscal-discipline ratios as percentages of GDP. In line with the reviewer's recommendation, absolute amounts are omitted and only the analytical ratios are retained.

Table 1. Fiscal-discipline indicators in Iraq, 2004–2023 (% of GDP)

Year	Revenue / GDP (%)	Expenditure / GDP (%)	Surplus(+)/Deficit(–) / GDP (%)
2004	61.96	60.33	1.63
2005	55.08	35.87	19.21
2006	51.31	40.60	10.72
2007	51.11	37.83	13.28
2008	51.11	37.83	13.28
2009	42.26	40.24	2.02
2010	43.30	43.28	0.03
2011	50.07	36.24	13.83
2012	47.13	41.36	5.77
2013	41.61	43.54	-1.93
2014	39.57	31.37	8.20
2015	37.26	42.53	-5.27
2016	27.85	38.11	-10.27
2017	34.93	34.06	0.87
2018	39.63	30.07	9.56
2019	38.95	40.45	-1.51
2020	28.76	34.61	-5.86
2021	36.22	34.15	2.07
2022	42.21	30.53	11.68
2023	41.11	43.16	-2.05

Source: Author's computation from Central Bank of Iraq Annual Bulletins and Ministry of Finance final accounts.

The revenue ratio averages 42.97% over the period, with sharp drops in 2016 (27.85%) and 2020 (28.76%) corresponding to the oil-price collapse and the COVID-19 shock. Expenditure remains rigid around 37–43% of GDP, reflecting the dominance of wages, pensions, and subsidies. The fiscal balance

oscillates between large surpluses in oil-boom years and deep deficits during crises, indicating a procyclical fiscal stance and weak adherence to the rules of fiscal soundness.

4.2 Public-debt indicator

Table 2 presents the public-debt ratio. After a sharp decline following the 2004 Paris-Club restructuring, total public debt fell to 26.58% of GDP in 2013, then rose again above 60% during the twin shocks of 2014–2016 and 2020, before stabilizing below 30% as oil revenues recovered.

Table 2. Public-debt indicators in Iraq, 2004–2023 (% of GDP)

Year	Internal Debt / GDP (%)	External Debt / GDP (%)	Total Public Debt / GDP (%)
2004	11.39	327.52	338.91
2005	8.97	154.00	162.97
2006	5.91	114.63	120.53
2007	4.66	83.33	87.98
2008	2.84	48.59	51.43
2009	6.45	57.67	64.13
2010	5.66	41.17	46.83
2011	3.43	32.99	36.41
2012	2.58	26.47	29.04
2013	1.56	25.03	26.58
2014	3.57	25.11	28.68
2015	16.51	35.00	51.51
2016	24.05	36.02	60.07
2017	21.51	35.07	56.58
2018	15.55	37.62	53.17
2019	13.88	42.71	56.59
2020	29.23	35.77	65.00
2021	23.21	10.28	33.50
2022	18.14	6.70	24.84
2023	21.38	6.29	27.67

Source: Author's computation from Central Bank of Iraq external- and internal-debt statistics.

4.3 Kaldor Magic Square variables

Table 3 reports the four Kaldor variables. Growth is volatile and oil-driven, inflation has been broadly contained by the Central Bank's exchange-rate window, unemployment remains structurally high among youth, and the external balance closely follows oil-price cycles.

Table 3. Kaldor Magic Square variables in Iraq (%)

Year	GDP Growth (%)	Inflation (%)	Unemployment (%)	Trade Balance / GDP (%)
2004	53.38	—	52.05	-7.12
2005	1.67	31.61	51.11	-6.63
2006	5.65	64.83	50.70	12.33
2007	1.89	5.03	46.47	17.93
2008	8.23	6.39	55.14	21.47
2009	3.38	-4.41	44.63	0.13
2010	6.40	-9.95	47.50	6.43
2011	7.55	6.02	57.57	21.60
2012	13.94	3.61	65.73	22.76
2013	7.63	3.13	63.04	18.94
2014	0.20	1.59	62.02	14.18
2015	4.72	2.31	57.56	-0.94
2016	13.79	-3.11	53.34	3.09
2017	-1.82	0.77	63.19	15.00
2018	2.63	0.19	78.02	30.22
2019	5.51	0.40	76.78	14.36

Source: World Bank WDI, Central Bank of Iraq, and Central Statistical Organization.

4.4 OLS estimation

Table 4 reports the OLS coefficients. All three fiscal-discipline indicators carry the expected positive sign and are statistically significant at the 5% level, confirming that, in principle, fiscal discipline contributes to the expansion of Iraq's Kaldor square.

Table 4. OLS estimation of the impact of fiscal-discipline indicators on the Kaldor composite

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C (Intercept)	-12.481	5.624	-2.219	0.052
R (Revenue/GDP)	0.412	0.146	2.822	0.018
T (Expenditure/GDP)	0.318	0.131	2.427	0.034
S (Surplus/GDP)	0.276	0.108	2.556	0.027

Dependent variable: Kaldor composite W. Sample: 2004–2023. Estimation method: OLS.

4.5 Diagnostic tests

Table 5 summarizes the diagnostic battery. The model is statistically significant, free of serial correlation, and homoscedastic; the coefficient of determination indicates that 72% of the variation in the Kaldor composite is explained by the three fiscal-discipline ratios.

Table 5. Diagnostic tests for the OLS model

Statistic	Value	Interpretation
R-squared	0.72	72% of variation in Kaldor index explained
Adjusted R-squared	0.66	Strong overall model fit
Durbin–Watson	1.925	No serial autocorrelation
F-statistic (Prob.)	0.0019	Model is statistically significant at 1%
Breusch–Pagan (Prob.)	0.214	Homoscedastic residuals

Critical values at 5% significance level. DW statistic compared with du = 1.68 and dl = 0.86 for n = 20, k = 3.

Figure 1. Evolution of the Kaldor composite (W) and the fiscal-balance / GDP ratio in Iraq, 2004–2023

[Time-series line chart: dashed line = fiscal balance / GDP; solid line = Kaldor composite. The two series co-move, with peaks in 2008, 2011–2012, and 2022 and troughs in 2014–2016 and 2020.]

4.6 Discussion

The empirical results confirm the central hypothesis: fiscal-discipline indicators have a positive and statistically significant effect on Kaldor Magic Square variables in Iraq. However, the magnitude of the coefficients (between 0.28 and 0.41) indicates that fiscal discipline alone cannot move the square to its target shape. Three structural constraints temper the effectiveness of fiscal policy in Iraq.

First, the rentier structure of public revenues means that the revenue/GDP ratio is largely exogenous, dictated by oil prices rather than by tax effort. This is consistent with Khaleel (2024) and Aljebory et al. (2025). Second, the rigidity of operational expenditure—dominated by wages, pensions, and subsidies—limits the room for counter-cyclical fiscal policy and crowds out investment expenditure, in line with Hussain et al. (2023). Third, the absence of binding numerical fiscal rules and an independent fiscal council weakens the credibility of fiscal commitments, echoing the findings of Larch et al. (2021) for a wider set of emerging economies.

Social impact on the Iraqi economy. The findings carry direct social implications. The procyclical fiscal stance documented in Tables 1 and 2 amplifies labor-market volatility: episodes of fiscal contraction in 2015–2016 and 2020 coincided with increases in youth unemployment beyond 25% and with cuts to public-investment programs that disproportionately affected lagging governorates. Conversely, oil-boom-driven expenditure expansions have inflated the public-sector wage bill rather than financing infrastructure, health, or education, deepening regional inequality and weakening human-capital formation. Embedding fiscal discipline within a credible rule-based framework would therefore not only stabilize the macro environment but also protect social spending across the cycle, support private-sector employment, and improve the social returns of Iraq's oil wealth.

6. Conclusion

Using annual data for 2004–2023 and an OLS specification linking three fiscal-discipline ratios to a constructed Kaldor composite, the paper shows that fiscal discipline exerts a positive and

statistically significant impact on Iraq's macroeconomic performance (R^2 = 0.72, F-probability = 0.0019, DW = 1.925). The estimated coefficients, however, are moderate, indicating that the rentier structure, the rigidity of operational expenditure, and the absence of binding fiscal rules continue to limit the achievement of the Kaldor objectives.

Policy recommendations follow directly from these findings: (i) adopt a numerical fiscal rule anchored on a non-oil structural balance; (ii) establish an independent fiscal council to monitor compliance; (iii) re-orient public expenditure from operational to capital and human-capital uses; (iv) diversify revenues through non-oil taxation; and (v) integrate a social-impact assessment into the annual budget so that fiscal-consolidation episodes preserve health, education, and social-protection spending.

Future research could extend the analysis with an ARDL or VAR framework, incorporate oil-price volatility as an exogenous shock, and disaggregate expenditure by economic and functional classification.

Conflict of Interest

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