

# Analysis of the Effect of Hedging Against Exchange Price Fluctuations in the Electronic Window of the Central Bank of Iraq on the Tax Gap Index

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**Abstract:** This study investigates the impact of exchange rate risk management, proxied by hedging activities, on the tax gap index in Iraq over the period 2010–2018. Using annual macroeconomic data obtained from the Central Bank of Iraq and the Ministry of Planning, the research employs descriptive statistics, correlation analysis, and multiple regression techniques to examine the relationship between exchange rate fluctuations and fiscal sustainability indicators. The empirical results indicate a statistically significant relationship between hedging practices and the tax gap index, with hedging explaining approximately 31.5% of the variation in fiscal imbalance ( $R^2 = 0.315$ ). Furthermore, the findings reveal that exchange rate risk management is significantly associated with key macroeconomic variables, including public expenditure, real interest rates, and economic growth. The study concludes that while hedging mechanisms contribute to reducing the adverse fiscal effects of exchange rate volatility, their impact is partial and operates within a broader macroeconomic framework. The results highlight the importance of integrating exchange rate stabilization policies with tax administration reforms to enhance fiscal sustainability in developing economies.

## 1 INTRODUCTION

Many countries, especially developing countries such as Iraq, face economic challenges stemming from exchange rate fluctuations, which are among the most prominent factors affecting national economic stability. These fluctuations affect several aspects of the economy, including the state's tax revenues, which are a primary source of public financing and are crucial to achieving financial sustainability. With the continuous fluctuations in the exchange rate, the tax gap, which expresses the difference between expected and actually collected taxes, increases, which weakens the state's ability to achieve its financial goals and meet its public needs.

In this context, hedging strategies and tools have emerged to reduce the negative effects of exchange rate fluctuations. The main problem of the research is to what extent hedging can positively affect the tax gap index and whether this hedging contributes to improving the tax system's efficiency and enhancing its financial sustainability. The research seeks to provide a deeper understanding of hedging mechanisms against exchange rate fluctuations and

their impact on the efficiency of the tax system. The importance of the research is highlighted in the following:

- 1) It seeks to provide a deeper understanding of the mechanisms for hedging against exchange rate fluctuations.
- 2) Exchange rates directly affect companies' profits and losses.
- 3) Contribute to providing recommendations to government agencies and central banks on how to use hedging tools and strategies more effectively to support tax revenues.
- 4) Studying the impact of hedging helps exchange rate fluctuations enhance the economy's ability to deal with changes in exchange rates.

The research also addresses the following objectives:

- 1) Analysis of exchange rate fluctuations of the currency window and the parallel market in the Iraqi market within the study period.
- 2) Reviewing exchange rate policies and their importance in economic activity.
- 3) Identify the factors affecting the exchange rate and how to determine these.

Research hypotheses were formulated in line with the research problem as follows:

- 1) The use of exchange rate hedging instruments helps to mitigate exchange rate risks.
- 2) There is a statistically significant effect of hedging against exchange rate fluctuations on the tax gap index.

The research community represents the Iraqi economy and includes all institutions and indicators related to the exchange rate, financial policies and financial sustainability. In light of this, all financial and statistical indicators and data issued by the Central Bank of Iraq and the Ministry of Planning were relied upon, as they provide official data on the exchange rate and financial sustainability. The research sample comprised financial data extracted from the Central Bank and the Ministry of Planning for the period 2010-2018, related to the research variables. Methods of collecting data and information can be depicted as:

- 1) The theoretical aspect: data were collected from available sources that addressed the research topic.
- 2) The practical aspect is represented in the financial and statistical reports issued by the Central Bank and the Ministry of Planning during the research period

## 2 THE THEORETICAL ASPECT OF THE RESEARCH

### 2.1 Exchange Rates

It is known that every country may deal in legal currency and settle obligations by transferring bank deposits or savings fund deposits through checks or transfers or according to bills of exchange or commercial papers denominated in the local currency, except when the state deals with several countries, this mechanism stops working, and a system for transferring the local currency from one to another is required [1]. The exchange rate is the price of one currency of a particular country relative to another country's currency. It can be expressed as a unit of foreign currency against one unit of local currency. It is thus one of the most prominent foundations on which economic and trade relations between countries depend [2]. Here, the exchange rate serves as the mechanism by which the local economy is linked to other economies. It is a means of influencing the allocation between economic

sectors, the profitability of export industries, and the cost of imported resources [3].

### 2.2 Exchange Rate Risks

The negative effects of exchange rate fluctuations are a major concern, as high exchange rate uncertainty makes expectations about the future price level more ambiguous. Exchange rate volatility leads to a risk premium for long-term arrangements, increases production costs, reduces trade, and causes an unexpected redistribution of wealth, leading to fluctuations in the real currency and negative effects on the unemployment rate, poverty rate, balance of payments deficit, and consumption growth [4]-[6]. Exchange rate risks are an important topic for companies and investors operating in the global economy. Risk concerns the future, and the future is unknown. If the risk occurs, it represents an actual loss; if it does not, it provides opportunities to achieve higher returns [7], [8].

### 2.3 Hedging

Hedging is to protect from the risks of negative price fluctuations. The main goal of many hedgers is to reduce or avoid basis risk (market risk). In other words, the higher the basis risk, the greater the difference between the present price and the future price, the greater the risk to which the investor is exposed, and the opposite is true [9]. Hedging is defined as the transactions that an investor enters into with future execution dates to limit the losses that he may be exposed to due to adverse changes in the prices of (the commodity or securities) subject to the contract. If hedging protects the investor, it involves costs equal to the difference between the contract's cash flows under hedging and in the absence of hedging. Financial hedging includes reducing potential losses and protecting against adverse market movements.

### 2.4 Tax Gap

Governments are keen to enhance their tax revenues by reducing the tax gap, which is the difference between what should be collected from taxes and the taxes actually collected. The lack of sufficient tax revenues hinders the state from achieving the desired economic growth and sometimes prevents it from performing its functions efficiently. Therefore, addressing uncollected taxes is necessary to increase the state's tax revenues and finance public spending programs. The tax gap is one indicator of financial

sustainability. It indicates the level of tax burden necessary to stabilise the ratio of public debt to GDP, as it measures the difference between the tax rate that achieves financial sustainability and the current tax rate [12].

### 3 RESULTS

#### 3.1 The Market Exchange Rate Analysis

The results presented in Table 1 and Figure 1 indicate that the overall average market exchange rate during the study period (2010–2018) was 1227.59 dinars. In 2010, the exchange rate remained stable with an annual average of 1185 dinars. In 2011, the average increased slightly to 1195.56 dinars, with the lowest monthly values recorded in the first quarter (1185 dinars), reflecting a deviation of -0.88% from the annual mean, while the highest value was observed in December (1216 dinars), with a positive deviation of 1.76%.

In 2012, the average exchange rate rose to 1232.88 dinars, with the minimum value recorded in October (1200.04 dinars, -2.66% deviation) and the maximum in April (1262 dinars, +2.39%). A similar pattern of moderate fluctuation was observed in 2013,

where the annual average reached 1231.99 dinars; the lowest value was recorded in August (1209.62 dinars, -1.82%), while the highest was observed in May (1269 dinars, +3.03%).

In 2014, the average exchange rate declined slightly to 1213.56 dinars. The lowest value was recorded in November (1200 dinars, -1.12%), while higher values (1222 dinars) were observed in several months, indicating relative stability with limited variation.

In 2015, the average increased to 1247.6 dinars, with notable volatility: the lowest value was recorded in December (1216 dinars, -2.53%), while the highest peak occurred in June (1310 dinars, +5.02%), indicating increased market pressure.

In 2016, the average further increased to 1274.91 dinars. The minimum value was observed in February (1239.4 dinars, -2.79%), while the maximum reached 1303 dinars in December (+2.21%), reflecting sustained volatility.

In 2017 and 2018, the average exchange rates were 1257.94 and 1208.9 dinars respectively, indicating a downward adjustment in 2018 after a relatively stable period in 2017.

Overall, the results demonstrate moderate but persistent fluctuations in the market exchange rate across the study period, with noticeable peaks in 2015–2016 followed by partial stabilization in subsequent years.

Table 1: Average market exchange rates monthly.

Month	2010	2011	2012	2013	2014	2015	2016	2017	2018
JAN	1185	1185	1205.429	1225.75	1222.04	1220.7	1234.85	1291.73	1246.41
FEB	1185	1185	1235.789	1231.7	1222	1241	1239.4	1271.85	1228.6
MAR	1185	1185	1240	1254.84	1222	1269.5	1259.32	1253.76	1216.53
APR	1185	1186.429	1262.381	1267.05	1218.52	1296.5	1277.52	1250.47	1202.65
MAY	1185	1196.238	1251.261	1269.29	1222	1307.3	1283.55	1250.14	1199.71
JUN	1185	1197	1239.75	1236.74	1212.69	1310.2	1267.18	1247.24	1200.06
JUL	1185	1197.05	1253.714	1217.69	1214.79	1231.4	1271.63	1257.6	1200.86
AUG	1185	1198.545	1248.438	1209.62	1213.52	1217.1	1280.22	1254.77	1205.26
SEP	1185	1200	1229.1	1210.15	1203.62	1222.1	1288.65	1254.65	1206.33
OCT	1185	1200	1200.048	1220.22	1206.7	1220.1	1297.6	1259.1	1205.14
NOV	1185	1200	1207	1219	1200	1219	1296	1253	1200
DEC	1185	1216.571	1221.905	1222.28	1204.78	1216	1303.09	1250.95	1195.29
Mean	1185	1195.569	1232.881	1231.99	1213.56	1247.6	1274.91	1257.94	1208.9
Min	1185	1185	1200.048	1209.62	1200	1216	1239.4	1247.24	1195.29
Change	0.00%	-0.88%	-2.66%	-1.82%	-1.12%	-2.5%	-2.79%	-0.85%	-1.13%
Max	1185	1217	1262	1269	1222	1310	1303	1259	1206
Change	0.01%	1.76%	2.39%	3.03%	0.70%	5.02%	2.21%	0.09%	-0.21%
Change Min Max	0.01%	2.66%	5.19%	4.93%	1.83%	7.75%	5.14%	0.95%	0.92%
Total Mean	1227.59								

### 3.2 Window Exchange Rate Analysis

The results presented in Table 2 and Figure 2 indicate that the average exchange rate in the Central Bank of Iraq electronic currency window remained relatively stable over the study period. The overall mean value was 1185 dinars.

In 2010 and 2011, the average exchange rate was constant at 1183 dinars, with no significant monthly variation observed, indicating a stable intervention policy during these years. In 2012, the average slightly declined to 1179 dinars, with a marginal peak of 1181.5 dinars recorded in January, while all remaining months remained at approximately 1179 dinars.

A similar pattern of stability persisted in 2013, where the annual mean remained at 1179 dinars, with minimal variation between 1177 and 1179 dinars across months. In 2014, a moderate increase was observed, with the average rising to 1189.3 dinars. Monthly values ranged from a minimum of 1177 dinars in January to a stable level of 1190 dinars during most of the year.

For the period 2015–2018, the exchange rate in the window system stabilized at an average level of approximately 1190 dinars, with negligible monthly fluctuations.

Overall, the findings suggest that the Central Bank’s electronic currency window maintained a high degree of exchange rate stability compared to the

market rate, particularly during the later years of the study period.

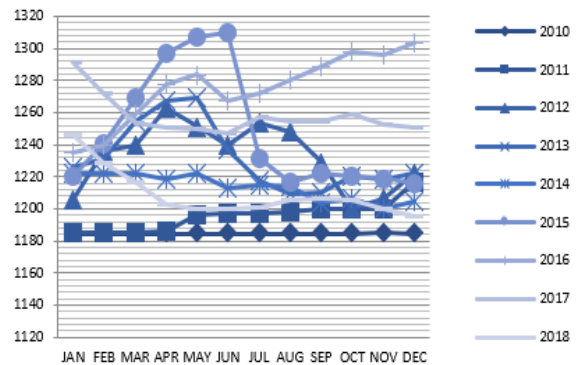


Figure 1: Average Market Exchange Rates every month.

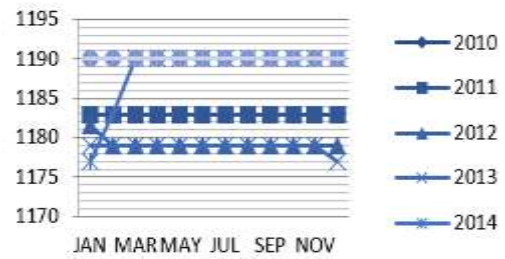


Figure 2: Average window exchange rates, source: prepared by the researcher based on data from the central bank of Iraq and the ministry of planning.

Table 2: Average window exchange rates.

Month	2010	2011	2012	2013	2014	2015	2016	2017	2018
JAN	1183.0	1183.0	1181.5	1179.0	1177.0	1190.0	1190.0	1190.0	1190.0
FEB	1183.0	1183.0	1179.0	1179.0	1183.0	1190.0	1190.0	1190.0	1190.0
MAR	1183.0	1183.0	1179.0	1179.0	1190.0	1190.0	1190.0	1190.0	1190.0
APR	1183.0	1183.0	1179.0	1179.0	1190.0	1190.0	1190.0	1190.0	1190.0
MAY	1183.0	1183.0	1179.0	1179.0	1190.0	1190.0	1190.0	1190.0	1190.0
JUN	1183.0	1183.0	1179.0	1179.0	1190.0	1190.0	1190.0	1190.0	1190.0
JUL	1183.0	1183.0	1179.0	1179.0	1190.0	1190.0	1190.0	1190.0	1190.0
AUG	1183.0	1183.0	1179.0	1179.0	1190.0	1190.0	1190.0	1190.0	1190.0
SEP	1183.0	1183.0	1179.0	1179.0	1190.0	1190.0	1190.0	1190.0	1190.0
OCT	1183.0	1183.0	1179.0	1179.0	1190.0	1190.0	1190.0	1190.0	1190.0
NOV	1183.0	1183.0	1179.0	1179.0	1190.0	1190.0	1190.0	1190.0	1190.0
DEC	1183.0	1183.0	1179.0	1177.0	1190.0	1190.0	1190.0	1190.0	1190.0
Mean	1183.0	1183.0	1179.0	1179.0	1189.3	1190.0	1190.0	1190.0	1190.0
Min	1183	1183	1179	1177	1177	1190	1190	1190	1190
Change	0.00%	0.00%	0.00%	-0.17%	-0.53%	0.00%	0.00%	0.00%	0.00%
Max	1183	1183	1181	1179	1190	1190	1190	1190	1190
Change	0.00%	0.00%	0.00%	0.00%	0.06%	0.00%	0.00%	0.00%	0.00%
Change Min Max	0.00%	0.00%	0.00%	0.17%	0.60%	0.00%	0.00%	0.00%	0.00%
Total Mean	1185.92								

Table 3: Hedging rates during the research period.

	2010	2011	2012	2013	2014	2015	2016	2017	2018
JAN	6.97%	1.01%	9.38%	10.67%	30.98%	18.59%	13.59%	20.95%	20.41%
FEB	7.17%	1.11%	9.35%	15.67%	26.25%	19.62%	13.68%	21.44%	18.34%
MAR	6.51%	1.41%	6.79%	23.83%	19.90%	37.05%	13.11%	25.41%	18.61%
APR	4.40%	2.81%	5.89%	32.40%	25.01%	23.74%	12.49%	27.91%	20.18%
MAY	3.54%	11.88%	3.92%	25.68%	28.87%	15.42%	11.99%	28.35%	22.03%
JUN	6.75%	3.87%	5.43%	21.58%	27.95%	16.16%	14.56%	15.89%	29.73%
JUL	10.16%	3.76%	6.40%	23.62%	30.13%	19.15%	19.21%	7.00%	22.76%
AUG	10.93%	4.28%	5.50%	21.55%	30.11%	12.72%	23.49%	1.63%	20.14%
SEP	15.69%	4.35%	5.79%	25.63%	29.76%	13.68%	15.89%	1.37%	17.75%
OCT	7.78%	4.97%	8.83%	25.41%	26.32%	12.32%	15.57%	1.23%	17.00%
NOV	2.70%	5.75%	13.90%	25.97%	30.68%	12.75%	15.17%	20.44%	13.92%
DEC	0.55%	8.03%	12.52%	23.91%	23.55%	16.85%	16.18%	21.72%	12.00%
Overall average	6.93%	4.44%	7.81%	22.99%	27.46%	18.17%	15.41%	16.11%	19.41%
Lowest recorded value	0.55%	1.01%	3.92%	10.67%	19.90%	12.32%	11.99%	1.23%	12.00%
Highest recorded value	15.69%	11.88%	13.90%	32.40%	30.98%	37.05%	23.49%	28.35%	29.73%

Table 4: Analysis of the tax gap index during the research period.

Year	PD	GDP	GS	Tax	GT	Tax/GDP	r	gt	GDP/T	(gt-rt)bt	Tax Gap
2010	75,900,000	162,064,565.5	70134200.2	1532438	43.28%	0.95%	3.85	6.4	46.83%	1.19	(0.761)
2011	79,127,000	217,327,107.4	78757667	1783593	36.24%	0.82%	0.4	7.55	36.41%	2.60	(2.241)
2012	73,832,000	254,225,490.7	105139575	2633357	41.36%	1.04%	-0.1	13.94	29.04%	4.08	(3.664)
2013	72,720,000	273,587,529.2	119127556	2876856	43.54%	1.05%	4.1	7.63	26.58%	0.94	(0.503)
2014	78,542,000	266,332,655.1	112192126	1885127	42.12%	0.71%	3.8	0.2	29.49%	(1.06)	1.483
2015	108,183,000	194,680,971.8	70417515	2015010	36.17%	1.04%	4.6	4.72	55.57%	0.07	0.295
2016	126,021,000	196,924,141.7	67067497	3861890	34.06%	1.96%	3.83	13.79	63.99%	6.37	(6.033)
2017	125,814,000	221,665,709.5	75490120	6298272	34.06%	2.84%	3.8	-1.82	56.76%	(3.19)	3.530
2018	90,776,000	268,918,874.0	111723523	5686211	41.54%	2.11%	3.6	2.63	33.76%	(0.33)	0.743

### 3.3 Hedging Analysis During the Research Period

Table 3 presents the evolution of hedging rates over the study period (2010–2018). The results indicate substantial variation across both months and years, reflecting changes in exposure to exchange rate risk and the intensity of risk management practices.

At the monthly level, the highest hedging rate was recorded in March 2015 (37.05%), while the lowest value was observed in December 2010 (0.55%), indicating significant heterogeneity over time.

At the annual level, hedging activity shows a general upward trend with intermittent fluctuations. In 2010, the average hedging rate was 6.93%, ranging between 0.55% and 15.69%. In 2011, the mean declined to 4.44%, with values fluctuating between 1.01% and 11.88%, reflecting relatively weak hedging activity.

In 2012, the average increased to 7.81%, with moderate variation across months (3.92%–13.90%). A more pronounced increase is observed in 2013,

where the average reached 22.99%, with a range between 10.67% and 32.40%, indicating stronger engagement in hedging mechanisms.

In 2014, hedging remained relatively high, averaging 27.46%, although monthly values showed moderate dispersion between 19.90% and 30.98%. In 2015, the average declined to 18.17%, despite a peak of 37.05% in March, suggesting short-term volatility in hedging intensity.

In 2016 and 2017, hedging activity stabilized at moderate levels, with averages of 15.41% and 16.11% respectively. However, 2017 exhibited sharp intra-year variation, ranging from 1.23% to 28.35%. In 2018, the average hedging rate increased again to 19.41%, with values fluctuating between 12.0% and 29.73%.

Overall, the results indicate that hedging activity is highly dynamic and responsive to exchange rate uncertainty, with no fully stable long-term pattern.

### 3.4 Analysis of The Tax Gap Index During the Research Period

The tax gap index reflects the difference between potential tax revenues required for fiscal sustainability and actual collected revenues. A lower or negative value indicates improved fiscal performance, while a positive value suggests the existence of a fiscal gap and potential inefficiencies in tax collection.

The empirical results in Table 4 show that the tax gap index fluctuated significantly during the study period (2010–2018). In several years, the index recorded negative values, indicating relative fiscal sustainability. Specifically, in 2010, tax revenues amounted to 1,532,438, with a tax gap of -0.761. In 2011 and 2012, the tax gap further declined to -2.241 and -3.664 respectively, reflecting improved fiscal conditions.

In 2013, the tax gap remained negative at -0.503, despite an increase in tax revenues to 2,876,856. A more pronounced deterioration is observed in 2016, where the tax gap reached -6.033 alongside revenues of 3,861,890, indicating improved relative fiscal balance in terms of the constructed index.

However, several years exhibit positive tax gap values, suggesting fiscal pressure and reduced sustainability. In 2014 and 2015, the tax gap turned positive at 1.483 and 0.295 respectively. A similar pattern is observed in 2017 and 2018, where the tax gap reached 3.530 and 0.743 respectively, despite relatively high tax revenue levels.

Overall, the findings indicate an unstable pattern of fiscal sustainability over the study period, with alternating phases of improvement and deterioration in the tax gap index. This volatility highlights the sensitivity of fiscal outcomes to macroeconomic conditions and exchange rate dynamics.

### 3.5 Factor Analysis of Tax Gap Variables

The results of the factor analysis showed the presence of these variables, as shown in Table 5. The tax gap index yielded several important and acceptable variables, with factor loadings greater than 0.50, indicating acceptable interpretations.

Table 5: Important paragraphs within the first factor and their saturations.

Index	Variable	Loading
Tax Gap	Public Spending	-0.977
	Public Debt to GDP	0.826
	Spending to GDP Ratio	-0.590
	Public Debt	0.505

### 3.6 Testing the Impact of Hedging from Exchange Rate Fluctuations on the Tax Gap and Its Variables

Table 6 presents the results of the regression analysis examining the impact of hedging against exchange rate fluctuations on the tax gap index and its related macroeconomic variables. The model demonstrates a moderate explanatory power, with a coefficient of determination ( $R^2$ ) of 0.315, indicating that hedging activities account for approximately 31.5% of the variation in the tax gap index.

The estimated regression coefficient ( $\beta = 0.171$ ) suggests a positive relationship between hedging and the tax gap. The statistical significance of the model is confirmed by the t-test, where the calculated value ( $t = 2.374$ ) exceeds the critical value ( $t = 1.895$ ) at the 5% significance level. Similarly, the F-statistic ( $F = 5.635$ ) is higher than the tabulated value ( $F = 5.59$ ), confirming the overall significance of the model at a 95% confidence level.

Table 6: Results of the hedging effect of the gap index on the tax gap and its variables.

IV	DV	r	R <sup>2</sup>	$\beta$	$\alpha$	T	F	P	Relation
Hedging effect on gap index	Public Debt	0.135	0.018	348576.6	86327485	0.360	0.130	0.729	Not Support
	Public Spending	0.501	0.251	1393835	68272545.5	*2.362	*5.579	0.044	Support
	Tax Revenue	0.219	0.048	49662.97	2400394.4	0.593	0.352	0.572	Not Support
	Spending to GDP Ratio	0.178	0.032	0.091	37.76	0.478	0.228	0.648	Not Support
	Tax to GDP Ratio	0.103	0.011	0.010	1.238	0.274	0.075	0.792	Not Support
	Real Interest Rate	0.686	0.471	0.151	0.743	*2.493	*6.214	0.037	Support
	Real Growth Rate	-0.485	0.235	-0.342	11.444	*2.467	*6.086	0.038	Support
	Public Debt to GDP Ratio	-0.136	0.018	-0.247	45.884	0.364	0.133	0.727	Not Support
	(gt -rt)bt	-0.556	0.309	-0.170	3.829	*2.366	*5.598	0.047	Not Support
Tax Gap	0.561	0.315	0.171	-3.829	*2.374	*5.635	0.044	Not Support	

At the variable level, the results indicate that hedging has a statistically significant effect on public spending, the real interest rate, the real growth rate, and the  $(g_t - r_t)b_t$  indicator. However, no statistically significant impact is observed for the remaining fiscal variables included in the model.

Overall, the findings suggest that exchange rate hedging contributes moderately to explaining variations in fiscal outcomes, particularly through selected macroeconomic transmission channels, while its effect on the broader tax gap structure remains partially limited.

## 4 CONCLUSIONS

The empirical findings of this study demonstrate a statistically significant relationship between exchange rate hedging activities, implemented through the Central Bank of Iraq's electronic currency window, and fluctuations in the tax gap index over the period 2010–2018. Regression analysis indicates that hedging explains approximately 31.5% of the variation in the tax gap ( $R^2 = 0.315$ ), with a positive and statistically significant coefficient ( $\beta = 0.171$ ). The robustness of the model is confirmed by both the t-statistic ( $t = 2.374$ ) and the F-statistic ( $F = 5.635$ ) at the 5% significance level.

Furthermore, the results suggest that exchange rate hedging exerts differentiated effects across macroeconomic variables associated with fiscal sustainability. Significant relationships are observed for public expenditure, real interest rates, and real economic growth, indicating that hedging influences fiscal outcomes through multiple macroeconomic transmission channels. However, the impact on other fiscal indicators within the tax gap framework appears statistically insignificant.

Overall, the findings support the hypothesis that exchange rate risk management contributes to mitigating fiscal distortions arising from currency volatility. Nevertheless, the moderate explanatory power of the model suggests that fiscal performance is determined not only by hedging mechanisms but also by structural and institutional factors within the broader macroeconomic environment.

From a policy perspective, the results imply that strengthening exchange rate risk management frameworks may enhance fiscal stability in emerging economies such as Iraq. However, such measures should be complemented by comprehensive tax administration reforms and broader fiscal governance improvements to achieve sustainable fiscal outcomes.

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