



A Statistical Study to Analyze Impact of Governance on Combating Corruption by Using Time Series Models the Case of Iraq during (2005-2023)

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Abstract

This work is informed by a time analysis procedure to investigate evaluation of the study variables from 2005 to 2023, employing of time-series models to reveal the relationship between governance and corruption through application of EViews13. The corruption perceptions index is considered as dependent variable, government effectiveness and rule of law are assumed independent variables, whereas the corruption growth rate is control variable. To describe model variables, time series regression models are employed subsequently, the graphical analysis and Augmented Dickey-Fuller (ADF) test are applied to know time series stationarity. Also, the two tests are utilized to examine degree of integration, nature of stochastic approach for variables, in case dependent or independent, over study time. This is done to ensure that the time series of the variable is stationary, meaning that it has a constant mean across its values, a constant variance, and no trend. Moreover, the tests conducted at first and second differences to assess stationarity at a certain difference, ensuring achievement stationary series adequate for modeling. Furthermore, robustness and validity of the estimated model are evaluated by autocorrelation tests and diagnostic tests of residuals. The findings show that the graphical method applied to examine stationarity is not highly precise as it appears severe oscillations in all variables under study. This involves conducting a stationarity test for the time series in according to equation of constant and trend by using the ADF test under the first and second differences. At the second difference $I(2)$, all variables are stationary as results show and the model can estimate a statistically significance model, with a coefficient ($R^2 = 96.3\%$), referring that model can explain the changes in corruption perceptions and has a high explanatory potential. Also value of F-statistic is high, reaching (183.3882). The time-series results further demonstrate presence of a statistically significant relationship between corruption and governance. It is revealed that advancement of government effectiveness exhibited statistical significance at 99% confidence level, and it is considered one of crucial independent variables in decreasing growth of corruption. The results show that a one-unit increase in government effectiveness results an increase corruption reduction by approximately (53.43) points. Concerning acceleration of rule of law, it has major influence over reducing the corruption. The outcomes state a one-unit increase of advancing rule of law deceleration of corruption acceleration by approximately (26.42) points, at a 99% confidence level. Furthermore, value of the constant of estimated equation is (-0.07) at the 95% confidence level, suggests that there is an escalation of corruption because of absence of governance indicators, which driven by endogenous factors of Iraqi society. This characterizes the preceding value of corruption before adopting of governance regulations. In the model residuals, lack of autocorrelation is characterized by the Durbin-Watson, while value of S.E. of regression reveals a high level of estimation precision. Hence, it can be deduced that governance stringent procedures contribute to decreasing corruption rate over the study period.

Keywords: Time series; Unit root; Stationarity; (Dickey-Fuller ADF) test; Differencing

1. Introduction

DOI: <https://doi.org/10.54216/GJMSA.130102>

Received: October 19, 2025 Revised: December 08, 2025 Accepted: January 27, 2026

Time series is one of the statistical methods which interests in explaining the nature and behaviour of a phenomena over time periods. The future prediction that depends on it has an importance in statistical sciences which is considered by researchers. This importance comes because there is requirement for an accurate forecasting mechanism that we can depend for different fields [3][16].

This predictive system requires making time series models classified based on multiple- model variables. Time series analysis stands up three axioms. The first axiom is the linearity which means that the series is represented by a linear mathematical model. The second axiom suggests that series is normal, i.e. it follows normal distribution. The third axiom considers the series is stationary. This means that their mathematical and statistical properties do not depend on time [7].

Time series involves a precise description of the process that results the time series, and then using the results to predict its future behaviour. In addition to, controlling the process from which it is generated by noticing what might obtain when some of the parameters change [3]. The study undergoes many stages, starting diagnosis and then choosing the suitable model. Then, estimation of the model's parameters to know to what extent the characterized model is suitable with research data to be the future prediction is the last stage. Time series analysis is suitable technique for measuring effects and their relationship to different conditions. The essential idea is to separate individually the trend, seasonal, and periodical effects to know their impacts on observed values [4][16].

Research objective:

Aim this work is to examine governance influence to limit corruption for period stated above. Some time series patterns are applied to follow governance indexes with corruption growth and then testing their stabilities both of them. Evaluation of time series by incorporating the graphical analysis with ADF. This is done through the visual analysis together Dickey-Fuller Booster (ADF). The graphical analysis visually explains general attributes while ADF provides statistically evidence of the existence of a unit root, aiming to reach the best time series which is capable of showing change rate in corruption affected by over time. Also, using the first and second differences such that the time series can reach its stability and then identifying the suitable order of integration.

Research problem

Many studies deal with between governance and corruption, but these do not use advanced time series applications in explaining how they impact each other correctly. The same studies follow analytical and descriptive methods that do not analyze the strong correlation between them causing substantial deficiency in understanding relationship between them. This leads to employing time series to examine the natural influence of governance on corruption rate. An important question is appeared about governance effectiveness to limit the corruption and how time series instruments provide us suitably statistical clarification to make a time-series approach to expect corruption patterns because of the continuing changes in governance rules.

Time series:

It is a set of chronologically ordered observations and sequentially generated according to a specific time order. The main property for time series is not independent, that means it uses the previous observations aiming to do future predictions, following the behavior of the series' observations in the past and believing that events are similar [15]. There are two types, the first type is discrete time series, which is used when the time periods are equal and mainly used in applied field. It is obtained by recording fixed times or collecting of phenomena values for fixed time periods. The other type is continuous time series. The time series is called non-statistical or non-random when we can accurately predict the future behavior of the phenomenon that is represented by the time series from the past observations. And it is called statistical or random identify the probability structure of the future behavior of the phenomenon [1][3]. The time series consists two variables, the first is the explaining variable which represents time and the second is response variable that represents value of the studied phenomenon. The mathematical formula stated as below:

$$Y = f(t) \dots \dots \dots (1)$$

If there are other variable affect the phenomenon Y, then the formula will be [3][5]:

$$Y = f(t, X_1, X_2, X_3, \dots, X_n) \dots \dots \dots (2)$$

Stationarity:

Stationarity is an important factor in time series analysis because its absence leads to misleading results, also data modeling stipulates time series must be stationary. Stationarity means series's statistical behavior does not rely on

a certain time point, i.e., (Y_t) has statistical equilibrium value around μ_Y, σ^2_Y , (ACV) for (K) during a time interval ^{[3][10]}. It is often that standard studies consider mathematical and statistical procedures to identify stationarity, like differences method and ADF test to find unity root. Time series model is stationary if roots of this equation $\phi(B) = 0$ do not belong to a circle its radius is one, where $\phi(B)$ is a polynomial and (B) is its independent variable. Because this yields $|B| > 1$ ^[8]. There are two kinds of stationarity:

1- Strict stationary ^{[2][16]} :

It suggest probabilistic behaviors does not change over time, and joint probability distribution of $(Y_{t_1}, Y_{t_2}, \dots, Y_{t_n})$ is similar to probability distribution of $(Y_{t_1+k}, Y_{t_2+k}, \dots, Y_{t_n+k})$ for all time points (t_1, t_2, \dots, t_n) and any lag (k) .

$$F_{Y_{t_1}, Y_{t_2}, \dots, Y_{t_n}}(Y_{t_1}, Y_{t_2}, \dots, Y_{t_n}) = F_{Y_{t_1+k}, Y_{t_2+k}, \dots, Y_{t_n+k}}(Y_{t_1+k}, Y_{t_2+k}, \dots, Y_{t_n+k}) \dots \dots (3)$$

The above condition is fundamental requirement to ensure stationarity of all probabilistic and statistical features across time.

2. Weak or second-order stationarity ^{[2][16]}:

The probabilistic attributes of this series do not change over time and its instantaneous properties of first and second orders are constant. This type is mainly used in statistical fields because it satisfies the following statements:

1- Expectation of (Y_t) is constant value over time.

$$E(Y_t) = \mu, \quad \forall t \dots \dots \dots (4)$$

2- Stability of Variance

$$Var(Y_t) = \sigma^2, \quad \forall t \dots \dots \dots (5)$$

3-If the second moment has finite value, i.e. $E\{Y_t^2\} < \infty$, for all t , then

$$\begin{aligned} \gamma_k &= Cov(Y_t, Y_{t-k}) = E[(Y_t - \mu)(Y_{t-k} - \mu)] \\ &= E[(Y_{t+k} - \mu)(Y_t - \mu)] = \gamma_{-k} \dots \dots (6) \end{aligned}$$

When $k = 0$, it is an even and symmetric function about zero.

Testing methods of Stationarity ^{[7][9][10][14]}:

1- Graphical Diagram

This is an essential tool to know non-stationarity of time series data, because it is the first step in examining behavior of the series and attributes before starting using of statistical tests. It helps researcher to adopt early decisions about the needs to do differences or change the regression models aiming to stabilizing the series, which is an important condition in success of models.

This method shows visual hints and to identify seasonal changes or trend or non-stationary fluctuations of variance. In many cases, graphs contribute to assign a suitable difference degree and to notice the change of time series from non-stationary case into fixed series around a certain mean.

2-Enhanced Dickey-Fuller (ADF) Test ^{[6][7]}

It is an important and common usage statistical test, to find the unit root in time series and determine its stationarity. This test explains series is stationary or involves differences to change it into stationary. It is an enhanced version of traditional Dickey-Fuller by adding deceleration periods to treat autocorrelation problem aiming to make the

results are more reliable. This test relies on estimating a regression model which contains constant value or time trend, or both of them. Then comparing the evaluated statistic with critical values to test if there is unit root or not.

Equation of this test is stated below:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{i=1}^P \delta_i \Delta y_{t-i} + \varepsilon_t \dots \dots \dots (7)$$

Where:

y_t : series value at time (t)

Δy_t : first difference in series

α : constant

βt : time trend

y_{t-1} : the delayed value by one period (Lag 1)

γ : Unit root test coefficient

P: deceleration number

Δy_{t-i} : period delayed difference

δ_i : delayed differences coefficient

ε_t : random error term

Test hypothesis of enhanced Dickey-Fool:

H_0 : $\gamma = 0$, series is stationary (contains the unit root)

H_1 : $\gamma < 0$, series is non-stationary

The model is estimated after using OLS method to make decision. This decision results from comparing the statistic value of test with the corresponding values of Dickey-Fuller. If the obtained result has less value compared with its critical value, then (H_0) is rejected and (H_1) is acceptable and that series is stationary. However, if the evaluated value is bigger than its critical value, (H_0) is acceptable and (H_1) is rejected. This concludes time series is non- stationary.

Differences test ^{[4][7][9][14]}:

It is a fundamental instrument of series analysis, widely used to establish stationarity. It is, in particular, relied on when the models follow ARIMA and applied to know integration degree of a series. The essential aim is removing the general trend and long-lasting shocks, ensuring statistical features. This means that mean and variance do not change over time. The major principle behind for the test is to previous results are subtracted from current results. This procedure changes the series from non-stationarity into stationary series. This enables us to model it to be effectively statistical technique.

First: The first difference:

When series is non-stationary because of linear trend or non-stable change in value of mean, this test is used. This test aims to remove the reasons mentioned above making it ready for ADF test and reducing persistent behavior. It is considered the essential step in changing being non-stationary series of order I(1) to stationary of order I(0).

Many reasons make us to use this test, first there is an obvious upward or downward trend when we examine the graph, or slow ACF or failure to find the unit root like ADF test to refuse non-stationary hypothesis. Now after this change, the series has a constant mean and stationary variance, so it is stationary of order I(1).

Its equation is:

$$\Delta Y_t = Y_t - Y_{t-1} \dots \dots \dots (8)$$

Whereas:

ΔY : first difference

Y_t : value of time series at time t

Y_{t-1} : the previous value of time series at t

Second: The second difference:

This test is applied when the previous test fails to satisfy stationarity, then the series is called integral of the second order and denoted I(2). After employing this test, the series becomes more regular, when the original series was nonlinear or has increasing changes over time by removing these reasons to allow usage of ARIMA models that are (p,2,q) type.

The formula of this test is stated below:

$$\Delta^2 Y_t = Y_t - 2Y_{t-1} + Y_{t-2} \dots \dots (9)$$

Whereas:

$\Delta^2 Y_t$: the second difference

Y_t : value of time series at time (t)

Y_{t-1} : time series value at t-1

Y_{t-2} : time series value at t-2

After this transformation and the series became stationary, it is described to be integrated of second order, I(2). Thus, two factors are considered the to determine a number of applying the differences. The first factor is nature of series, and the second is the evaluated results of unit root test, for instance, ADF test. It is preferred to begin first difference, and examine second difference when is necessary to solve the complex problems or non-stationary variance.

Practical Aspect:

Hypothesis

There is a negative relationship has statistical significance between governance indicators and corruption which used in this model.

First: Model description

Regression model of time series will be employed to test the relationship mentioned earlier (in Iraq). The following table describes variables of the model.

Table 1: Model Variables Description

variable	The symbol	Description	Expected impact
dependent variable	CPI_t	Perceptions of corruption	positive
First independent variable	GOV_EFF_t	Government effectiveness	positive
The second independent variable	RULE_LAWt	Rule of law	positive
The controlling variable	GDP_GROWTH_t	growth rate	positive
Error limit	ϵ	random variable	---

With accordance to these variables, the model will be:

$$CPI_t = \beta_0 + \beta_1 GOV_EFF_t + \beta_2 RULE_LAWt + \beta_3 GDP_GROWTH_t + \epsilon_t \dots (10)$$

Second: Stationarity test

The stationarity test is applied to explain the stochastic features of independent and dependent variables over the test time aiming to ensure time series of variable becomes stationary. This shows time series has a constant mean and also a constant variance and it is without trend. Both of the graph and ADF test are applied by the researcher because they demonstrate if a time series is stationary or non-stationary^[11].

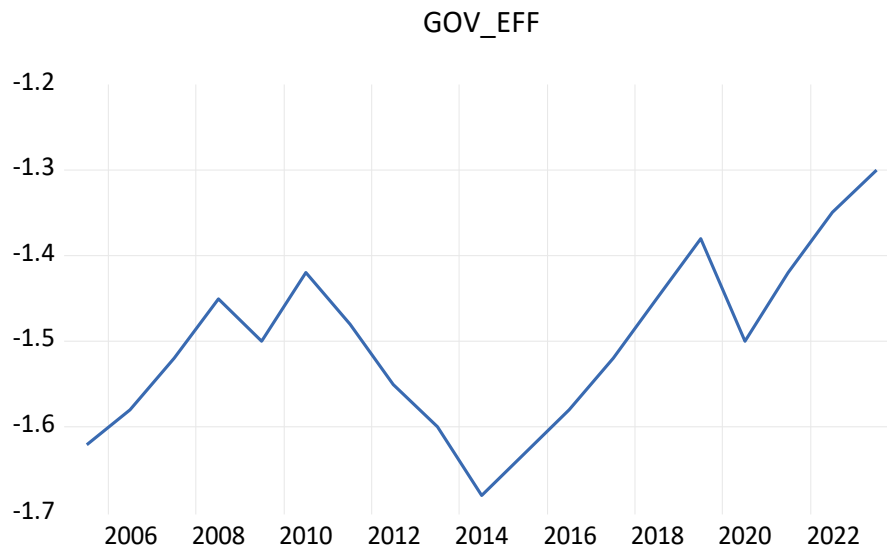


Figure 1. Graph of Government Effectiveness Indicator by Program EViews13

The graphical analysis shows that variable of government effectiveness, as an independent variable, is non-stationary in its values through study period, thereby this stipulates application of ADF test.

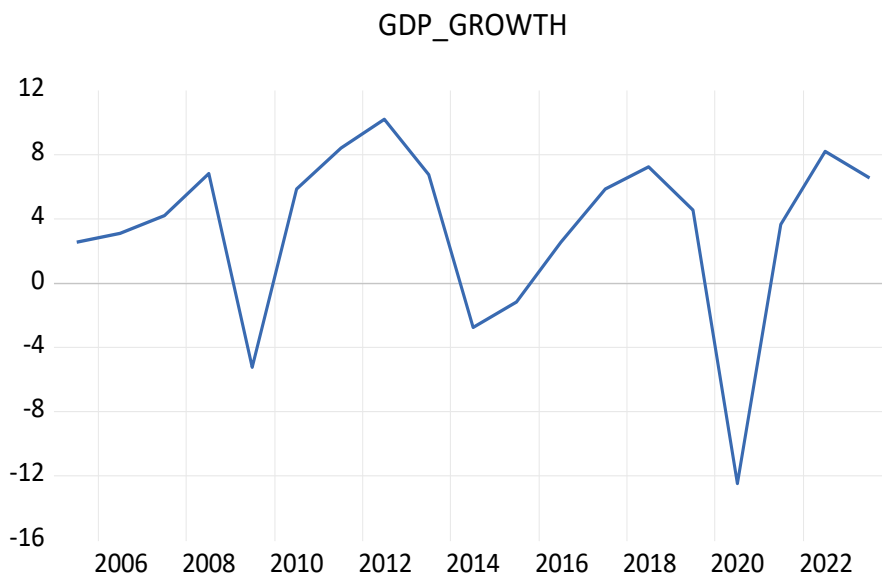


Figure 2. Graph of GDP growth rate using EViews13 program

The graph of GDP growth rate, as a control variable, explains non-stationarity of time series where it shows obvious fluctuations in its values during test period. Therefore, it necessitates using ADF test.

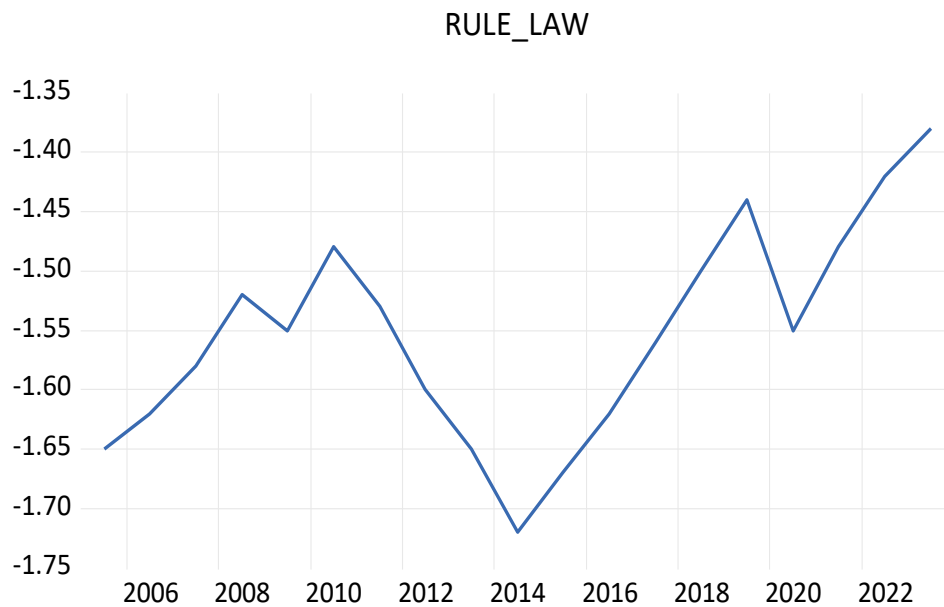


Figure 3. Graph of the Rule of Law Index using EViews13 program

The graphical analysis suggests indicator of rule of law, as an independent variable, is non-stationary because the series has fluctuations over test time. It involves to use ADF test.

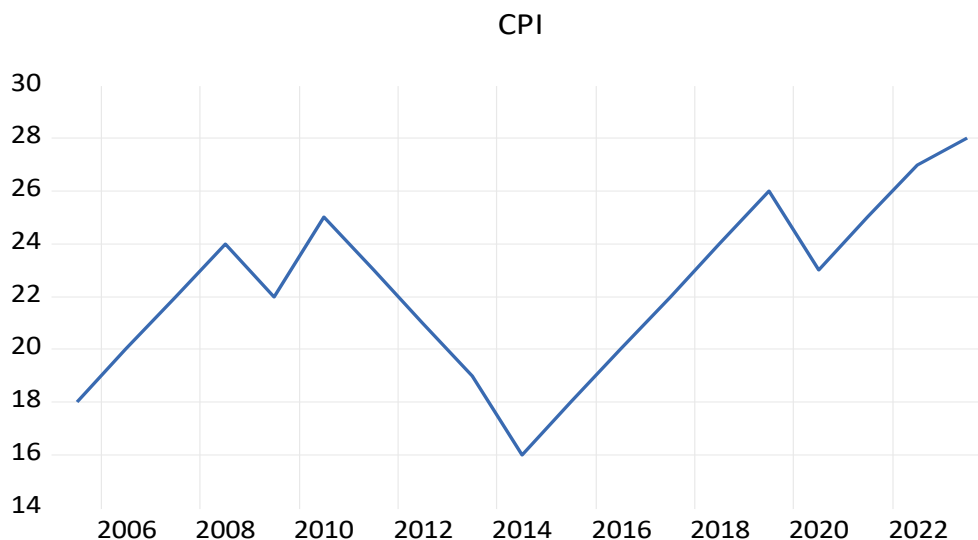


Figure 4. Graph of perceptions of corruption in Iraq for the period (2005-2023)

The diagram of corruption perceptions indicators, as a dependent variable in, states fluctuations in its value, so the series is non-stationary. Thus, it is required to apply ADF test.

After being informed by the graphical diagrams, the stationarity of this series within this model will be examined to know if it is stationary at a certain level of difference. This is made whether it is the first or second difference. Based on the results evaluated in the test, the integration test is employed ^[13].

A- Test of corruption perceptions: For all the variables listed in the model, ADF test will be applied to know stationarity of series. To keep brevity, the researcher will rely on specification that consists of both of constant and trend equation. Because this equation provides the highest probability that there is non-stationarity at 1% or 5% significance level, both are and rejected in statistical calculations.

Table 2: Stability test at the level of the time series of perceptions of corruption according to the constant and trend equation

Null Hypothesis: CPI has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=3)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.445944...	0.80990...
Test critical values: 1% level	-4.571559293204908	
5% level	-3.690814285193312	
10% level	-3.286908928697576	

*MacKinnon (1996) one-sided p-values.
 Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18

Since the results show p-value exceeds 0.05, then the zero hypothesis is rejected and the other hypothesis is accepted. The results indicate series is non-stationary at 0.05 significance level. Thereby, the researcher considers the first difference of the series and ADF test is reapplied to new series as explained in the table below.

Table 3: Stability test in the first difference of the time series of perceptions of corruption according to the constant and trend equation

Null Hypothesis: D(CPI) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=3)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.587100...	0.06180...
Test critical values: 1% level	-4.616209267595892	
5% level	-3.710482417178045	
10% level	-3.297799475292123	

*MacKinnon (1996) one-sided p-values.
 Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 17

Similarly, the results suggest that p-value is bigger than 0.05. It necessitates the null hypothesis is not acceptable, while the alternative hypothesis will be relied on. This means series is non-stationary at the 0.05 significance level. Accordingly, the first difference of the time series should consider and ADF test reapplied to the transformed series as appeared in the table:

Table 4: Stability test in the second difference of the time series of perceptions of corruption according to the constant and trend equation

Null Hypothesis: D(CPI,2) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=3)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.574983...	0.00040...
Test critical values: 1% level	-4.667883198293038	
5% level	-3.733200059736847	
10% level	-3.310348794894084	

*MacKinnon (1996) one-sided p-values.
 Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 16

By taking second difference results makes p-value is less than 0.05. So the new result stipulates accepting of null hypothesis and rejecting the alternative hypothesis. It shows stationarity of time series of dependent variable and denoted as I(2).

B- Test government effectiveness: Similar to the **(second)** dependent variable, the test of stationarity will be made for the **(first)** independent variable. The specification of constant and deterministic trend equation is depended on as it yields the best likelihood of testing stationarity at 1% or 5%, and both of these values are statistically accepted.

Table 5: Stability test at the level of the Government Effectiveness Index using the constant and trend equation

Null Hypothesis: GOV_EFF has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=3)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.312619...	0.85084...
Test critical values:		
1% level	-4.571559293204908	
5% level	-3.690814285193312	
10% level	-3.286908928697576	

*MacKinnon (1996) one-sided p-values.
 Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18

The results suggest that p-value exceeds 0.05. It means that null hypothesis is not acceptable and the second hypothesis is accepted. The outcomes indicate non-stationarity of at 0.05 significance level. Subsequently, the first difference of the time series is depended on and AFC test reapplied to transformed series as stated in the table below.

Table 6: Stability test in the first difference of the Government Effectiveness Index using the constant and trend equation

Null Hypothesis: D(GOV_EFF) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=3)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.671627...	0.05348...
Test critical values:		
1% level	-4.616209267595892	
5% level	-3.710482417178045	
10% level	-3.297799475292123	

*MacKinnon (1996) one-sided p-values.
 Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 17

In spite of the p-value tends to 0.05, it is preferable to apply the second difference to further satisfy stationarity of the series, relied on the specification containing constant and trend equation, as explained in table below.

Table 7: Stability test in the first difference of the Government Effectiveness Index using the constant and trend equation

Null Hypothesis: D(GOV_EFF,2) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=3)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.652703...	0.00035...
Test critical values:		
1% level	-4.667883198293038	
5% level	-3.733200059736847	
10% level	-3.310348794894084	

*MacKinnon (1996) one-sided p-values.
 Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 16

Therefore, government effectiveness index is stationary as its series shows that at order I(2).

C- Test of rule of law index: To avoid unimportant details, just the data corresponding to the stage where stationarity is realized, will be displayed and then interpretation of findings.

Table 8: Stability test at the level of the time series of the Rule of Law Index according to the constant and trend equation

Null Hypothesis: RULE_LAW has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=3)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-1.318463...	0.84922...
Test critical values: 1% level	-4.571559293204908	
5% level	-3.690814285193312	
10% level	-3.286908928697576	

*MacKinnon (1996) one-sided p-values.
 Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18

Table 9: Stability test in the first difference of the time series of the Rule of Law Index according to the constant and trend equation

Null Hypothesis: D(RULE_LAW) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=3)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.529201...	0.06815...
Test critical values: 1% level	-4.616209267595892	
5% level	-3.710482417178045	
10% level	-3.297799475292123	

*MacKinnon (1996) one-sided p-values.
 Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 17

Table 10: Stability test in terms the second for the time series of the Rule of Law Index according to the constant and trend equation

Null Hypothesis: D(RULE_LAW,2) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic - based on SIC, maxlag=3)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-6.351849...	0.00057...
Test critical values: 1% level	-4.667883198293038	
5% level	-3.733200059736847	
10% level	-3.310348794894084	

*MacKinnon (1996) one-sided p-values.
 Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 16

As in the preceding discussions, the time series of rule of law index (as an independent variable) is not stationary up to the second difference, where p-value at the level and in the first difference is higher than 0.05, while in second difference it is fewer than 0.05. Thus, the null hypothesis is acceptable; but we refuse the alternative hypothesis, and the variable order is I(2).

D- Test of GDP growth:

The following tables present results of stationarity test of GDP growth rate (as a control variable):

Table 11: Testing the stability of the time series of GDP growth rate according to the constant and trend equation

Null Hypothesis: GDP_GROWTH has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 2 (Automatic - based on SIC, maxlag=3)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.107841...	0.02640...
Test critical values: 1% level	-4.667883198293038	
5% level	-3.733200059736847	
10% level	-3.310348794894084	

*MacKinnon (1996) one-sided p-values.
 Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 16

From the table above, it can be seen that p-value is less than 0.05, which indicating to refusing alternative hypothesis and accepting the zero hypothesis, i.e., GDP growth rate is stationary at order I(0). It recommends the reliance on graphical data alone is not largely precise and using ADF test is crucial in this model. In addition to, it ensures that choosing the control variable, namely GDP growth rate is extremely accurate.

Third: Regression Estimation

At the second difference, I(2), all variables are stationary with accordance to results of stationarity tests. So, it is not necessary to employ integration test among variables of the model; rather it may rise model sophistication suggesting misleading outcomes. Therefore, the GDP growth rate (the control variable) is eliminated and the variables second difference are evaluated to estimate the regression model.

Table 12: Results of regression estimation using the second difference for model variables by the least squares method

Dependent Variable: D2_CPI				
Method: Least Squares				
Date:10/16/25 Time: 08:05				
Sample (adjusted): 2007 2023				
Included observations: 17 after adjustments				
Variable	Coefficient	Std .Error	t-Statistic	Prob
C	-0.074714	0.148612	-0.502749	0.0230
D2_Gov_EFF	53.43452	17.50661	3.052248	0.0086
D2_RULE_LAW	-26.41997	20.15777	-1.310659	0.0111
R-squared	0.963233	Mean dependent var		-0.058824
Adjusted R-squared	0.957981	S.D. dependent var		2.988950
S.E of regression	0.612694	Akaike info criterion		2.016883
Sum squared resid	5.255516	Schwarz criterion		2.163921
Log likelihood	-14.14351	Hannan –Quinn criter		2.350194
F-statistic	183.3882	Durbin-Watson stat		2.350194
Prob (F-statistic)	0.000000			

In this table, a statistically significant model is estimated and objective of this model has been satisfied, as the result is $R^2 = 96.3\%$, indicating it has high efficiency in explaining 96.3% of increasing changes in corruption perceptions. Therefore, the remaining which is 3.7% attributed to other omitted factors in the model. Furthermore, F-statistic reaches 183.3882 at 100% confidence level.

It is confirmed that the most significant independent variable in decreasing escalation of corruption is government effectiveness. When there is one-unit rise of government regulations, this will lead to an increase in the acceleration of corruption reduction by 53.43 points. This influence refers to statistically significant at 99% confidence level.

It is also established that rule of law (as second independent variable) has a noticeable effect on limiting of corruption, as an increment of rule of law, results declining of corruption by 26.42 points, at 99% confidence level.

The constant term in the estimated equation recommends that increased corruption ratio in case of failure of governance indicators will appear evil inclinations of Iraqi society, as shown by the negative signal of that term. This states corruption initial amount before applying of governance strategies at 95% confidence level.

Further, lack of autocorrelation is indicated by Durbin-Watson test, while S.E. of regression recommends high level of estimation.

3. Conclusion

1. The empirical results support, negation of the zero hypothesis and confirmation of the alternative hypothesis, referring a statistically significant negative relationship between corruption and the governance indicators in this model.
2. The visual analysis results of the graph confirm non-stationarity of time series for model variables at their levels, and exhibiting a trend in it accompanied by clear fluctuations.
3. The outcomes of ADF test suggest that null hypothesis should be refused at 5% significant level and the alternative hypothesis is accepted. This reveals presence of a unit root in this time series at the level, thereby justifying the graphical findings presented in the preceding conclusion 2.
4. The ADF test results stipulate acceptance of zero hypothesis at 5% significance level for GDP series. This refers to this series is free of unit root, and it is stationary at level $I(0)$.
5. After employing the first difference of the non-stationary time series at level, the results show non-stationarity of rule of law, corruption perceptions and government effectiveness at 5% significance level. As a result, stipulating the application of second difference and re-examination of ADF test.
6. The results of the ADF test (after applying the second difference) explain that time series for model variables is integrated of degree $I(2)$.
7. The OLS estimation outcomes report a negative relationship between governance indicators and corruption employed in the model and support of the study hypothesis.
8. In the model residuals, non-presence of autocorrelation is shown by results of Durbin-Watson and the standard error reveals model's predictive accuracy. This illustrates model's efficiency and satisfies the statistical conditions to do model of time series.

4. Recommendations

1. It is necessary to execute the unit root test before starting on statistical modeling, when there is an obvious trend and fluctuations in the graphical diagram.
2. If the series of model variables highlights the stationarity at level $I(0)$, the investigator can apply VAR model, or suppose it as control variable, considering the system complexity.
3. The model estimation by OLS method is applied, if all series are integrated at significance level, first difference, or second difference.
4. It is suggested to use different stationarity tests, (for short time series models), to obtain unbiased estimators and it is a fundamental statistical condition to model the time series.
5. For assuring accuracy of statistical analysis, the time differences are applied, particularly when presence of trends and sharp oscillations.

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