

E-Government and its role in reducing the phenomenon of corruption in the Arab countries during the period (2003-2020)

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BOUATELLI Mohamed*, Higher School of Management and
Digital Economy, Algeria

Email : mbouatelli@esgen.edu.dz

Abstract:

This study aims to analyze and evaluate the impact of E-Government on combating corruption in 17 Arab countries from (2003 to 2020). The method employed for this purpose is sectional time series data analysis using panel models implemented through the R program.

The findings reveal a significant and positive correlation between the development of E-Government and the Corruption Perceptions Index in Arab countries. Specifically, a 10 percent increase in the E-Government Development Index leads to a 0.54 percent rise in the Corruption Perceptions Index, indicating that enhancing E-Government initiatives may effectively mitigate corruption in Arab nations.

Keywords: E-Government; phenomenon of corruption; Arab Countries; Panel Models.

Jel Classification Codes: O17 ; O43 ; O53.

*Author correspondents

1. Introduction:

The concept of digital government, commonly known as e-government, represents a pivotal and contemporary idea in our current era. It is a modern approach that relies on the use of technologies in delivering services to individuals and institutions, thereby transforming the traditional mode of government service delivery into a digital format. In the same context, digital government primarily aims to improve the quality of government services provided, enhance their efficiency, and eliminate bureaucracy. This allows for reducing bribery and curbing the phenomenon of corruption, which tends to escalate in traditional service delivery. This negative phenomenon affects various aspects of social, economic, and political life, leading to several detrimental effects on the state, individuals, and institutions. These effects include hindering developmental processes, disrupting social security and stability, increasing poverty, injustice, and exploitation.

1.1. Problem Statement:

Building upon the aforementioned, the main problem of this study crystallizes as follows:

To what extent does digital government contribute to reducing the corruption in Arab countries?

1.2. Sub-questions:

- What is the reality of corruption in Arab countries?
- What is the nature of the relationship between digital government and the phenomenon of corruption in Arab countries?

1.3. Hypotheses:

- Arab countries, like other developing nations, witness significant spread of corruption;
- Digital government has a significant negative impact on the phenomenon of corruption in Arab countries.

1.4. Significance of the Study:

The significance of the research stems from the importance of digital government and its significant role in promoting integrity, transparency, accountability, and consequently protecting individuals and government and private institutions from all forms of corruption they may encounter.

1.5. Study Objectives:

This study aims to:

- Analyze the phenomenon of corruption in Arab countries;
- Attempt to identify the nature of the relationship between digital government and the phenomenon of corruption in Arab countries;
- Identify the mechanisms through which digital government works to reduce the phenomenon of corruption in Arab countries.

1.6. Methodology:

A descriptive-analytical methodology was utilized to analyze corruption perceptions index in Arab countries. Additionally, the standard quantitative methodology was employed to determine the extent to which digital government contributes to reducing the phenomenon of corruption in Arab countries, using the R software.

1.7. Previous Studies:

Several studies have explored the relationship between digital government and its effectiveness in combating corruption, yielding diverse findings based on sample populations, study durations, methodologies, and technological frameworks employed. Below, we present a synthesis of the key insights from these studies:

- **Study (Barkno & Thabeti, 2019):** This study aimed to highlight the role played by e-government in combating administrative corruption. It reviewed the experiences of India, South Korea, and Algeria. The study found that the implementation of e-government in Algeria does not meet the required standards. Additionally, it concluded the existence of an inverse relationship between e-government and administrative corruption in general.
- **Study (Al-Beiruti, Wafa, & Rabeha, 2014):** This study aimed to analyze the role of e-government in reducing administrative and financial corruption in the General Traffic Department in Iraq. To achieve this goal, a questionnaire was designed containing 35 questions distributed among a sample of 130 individuals. Statistical data were processed using SPSS software. The study concluded that the application and development of e-government have a significant impact on reducing administrative and financial corruption in Iraq.
- **Study (Mistry & Jalal, 2012):** This study, titled "Standard Analysis of the Relationship between E-Government and Corruption," aimed to examine the effect of e-government usage on corruption in several countries around the world. It investigated whether the impact of e-government on corruption is higher in developed or developing countries. The study used a sample consisting of 108 countries, covering the period between

2003 and 2010. It found that with an increase in e-government usage related to information and communication technology, corruption decreases. It also concluded that the impact of e-government is higher in developing countries than in developed countries.

1.8. Study Plan:

To address the main problem and test the hypotheses of the study, we first analyzed the corruption perceptions index in Arab countries. Then, we proceeded with the standard study to assess the impact of digital government on the phenomenon of corruption in Arab countries.

2. Analytical Study of the Corruption Perceptions Index in Arab Countries:

This analytical study begins with an examination of the evolution of corruption perceptions indices in Arab countries. Then, the Arab countries are classified according to their corruption perceptions index, followed by a comparative study between the Digital Government Development Index and the Corruption Perceptions Index in Arab countries.

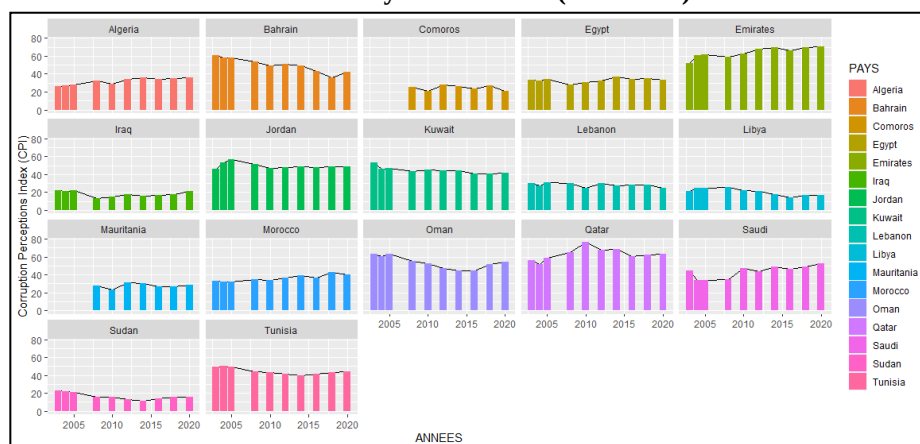
2.1. Evolution of the Corruption Perceptions Index in Arab Countries:

Based on Figure (1), on the evolution of corruption perceptions index for each Arab country during the study period from 2003 to 2020, it is observed that these countries can be classified into three groups.

The first group comprises four Arab countries that recorded positive and continuous development in the corruption perceptions index during the study period. These countries are the United Arab

Emirates, Algeria, Morocco, and Saudi Arabia. The United Arab Emirates showed the highest positive development among Arab countries in terms of the corruption perceptions index between 2003 and 2020, with an increase in the index value by 19 points, followed by Algeria with an increase of 10 points, then Saudi Arabia with approximately 8 points, and Morocco with around 7 points.

Fig.1. Evolution of the Corruption Perceptions Index for Each Arab Country in the Period (2003-2020)



Source: Prepared by the researcher based on R software

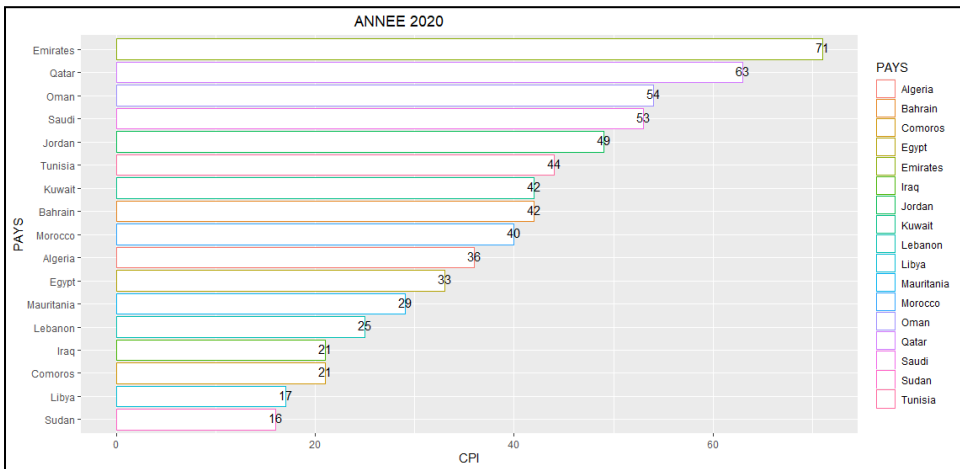
The second group also consists of four Arab countries that experienced negative development overall in the corruption perceptions index during the study period. These countries are Bahrain, Oman, Kuwait, and Sudan. Bahrain recorded the highest decline among Arab countries in terms of the corruption perceptions index between 2003 and 2020, with a decrease in the index value of 19 points, followed by Kuwait with a decrease of 11 points, then Oman with approximately 9 points, and Sudan with around 7 points.

Finally, the third group consists of nine Arab countries that witnessed unstable changes and developments in the corruption perceptions index, characterized by general fluctuations during the study period. These countries include Comoros, Egypt, Iraq, Jordan, Lebanon, Mauritania, Libya, Qatar, and Tunisia.

2.2. Classification of Arab Countries According to the Corruption Perceptions Index:

Through Figure (2), which represents the ranking of Arab countries based on the corruption perceptions index in 2020, it is noted that four Gulf countries topped the Arab ranking with an excellent index exceeding 50 out of 100. The United Arab Emirates ranked first in the Arab world with an index value of 71, followed in by Qatar, Oman, and Saudi Arabia.

Fig.2. Ranking of Arab Countries According to the Corruption Perceptions Index in 2020



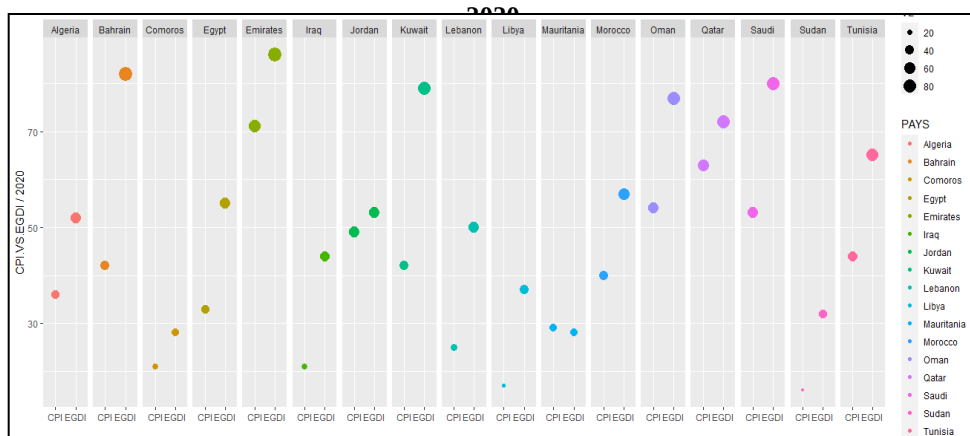
Source: Prepared by the researcher based on R software

Additionally, seven Arab countries ranked from 5th to 11th with an acceptable index exceeding 30 out of 100, including Jordan, Tunisia, Kuwait, Bahrain, Morocco, Algeria, and Egypt. Meanwhile, six Arab countries ranked in the last positions in the Arab classification from 12th to 17th with a weak index not exceeding 29 out of 100, namely Mauritania, Lebanon, Iraq, Comoros, Libya, and Sudan.

2.3. Comparative Study Between the Digital Government Development Index and the Corruption Perceptions Index in Arab Countries:

Through Figure (3), which presents a graphical summary for the comparison between Arab countries in terms of the Digital Government Development Index and the Corruption Perceptions Index in 2020, it is evident that all Arab countries, except Mauritania, had a higher Digital Government Development Index than the Corruption Perceptions Index. This indicates a significant lag in these countries in combating administrative and financial corruption.

Fig.3. Comparison between Arab Countries in terms of the Digital Government Development Index and the Corruption Perceptions Index in 2020



Source: Prepared by the researcher based on R software

3. Presentation of Study Data:

3.1. Study Methodology:

The study adopted both descriptive and inferential analysis methodologies, using panel data models and relying on the statistical software R to perform various statistical tests and estimate the study models.

3.2. Sample and Study Period:

The study period extends from 2003 to 2020. The reason for selecting this period is the availability of data related to the main study variables. The study sample included 17 Arab countries, representing most Arab countries for which data were available.

3.3. Data Sources:

Several international sources were relied upon to collect the data used in this study. The Corruption Perceptions Index data were obtained from the Transparency International data platform. Data related to the Digital Government Development Index were collected based on United Nations reports on e-government. As for the data of all other variables used in the study, they were obtained from the World Bank database.

3.4. Study Variables:

As a first step, a detailed presentation of all the variables relied upon is provided in the following table:

Table 1. Variables Constituting the Study Model

Variable Code	Variable Name	Variable Nature	Data Represented by the Variable	Source
CPI	Corruption Perceptions Index	Dependent	Scale from 0 to 100, where 0 indicates the most corrupt	Transparency International
EGDI	E-Government Development Index	Key Independent	Scale values confined between 0 and 1	United Nations reports on e-government
DP	Government Expenditure Rate	Independent	Percentage of final government consumption expenditure to GDP	World Bank data base
HDI	Human Development Index	Independent	Annual Human Development Index from UNDP	World Bank data base
RVI	Individual Income Level	Independent	Individual share of Gross National Income (at current USD)	World Bank data base
EXP	Goods and Services Exports	Independent	Percentage of goods and services exports to GDP	World Bank data base
DFI	Democracy and Freedom of Expression Index	Independent	Scale values confined between -2.5 and 2.5	World Bank data base
PSI	Political Stability Index	Independent	Scale values confined between -2.5 and 2.5	World Bank data base

Source: Prepared by the researcher

4. Descriptive Analysis of Study Data:

Table 2 presents the results of descriptive statistics for the study variables across all countries and time periods. It highlights the summary of variables, including the minimum value, maximum value, median, and mean.

Table 2. Descriptive Statistics for Study Variables

Variable Code	Minimum Value	Maximum Value	Median	Mean
CPI	11.00	77.00	36.50	38.71
EGDI	0.0000	0.8555	0.4374	0.4362
DP	7.297	56.854	16.375	16.953
HDI	0.4390	0.9120	0.7275	0.7073
RVI	586.8	85076.0	4607.3	13770.2
EXP	0.4358	102.1455	41.8684	43.8055
DFI	-1.9400	0.3000	-0.9150	-0.9585
PSI	-2.5	1.2200	-0.4650	-0.5434

Source: Prepared by the researcher based on R software

From the above table, concerning the main variables of the study represented by the dependent variable expressed by the Corruption Perceptions Index (CPI), in addition to the main independent variable represented by the E-Government Development Index (EGDI), we observe that:

- The highest value for the Corruption Perceptions Index (CPI) was recorded in Qatar in 2010 (77), while the lowest value was observed in Sudan in 2014 (11). The average mean for this index throughout the study period was 38.71;
- The highest value for the E-Government Development Index (EGDI) was recorded in the United Arab Emirates in 2020 (0.8555), while the lowest values were observed in Iraq and Libya in 2003 (0). The average mean for this index throughout the study period was 0.4362.

5. Study Model:

In order to measure the role of e-government in combating and reducing corruption in Arab countries, we constructed a model consisting of a dependent variable represented by the Corruption Perceptions Index (CPI), and a set of explanatory variables that we deemed necessary, important, and explanatory of corruption phenomena in Arab countries. These variables include the E-Government Development Index (EGDI) as a key independent variable, government expenditure rate, Human Development Index (HDI), individual income level, exports of goods and services, Democracy and Freedom of Expression and Press Index (DFI), in addition to the Political Stability Index (PSI). The the model can be written as follows:

$$\text{CPI} = f(\text{EGDI}, \text{DP}, \text{HDI}, \text{RVI}, \text{EXP}, \text{DFI}, \text{PSI})$$

6. Stability Analysis of Study Variables:

Before examining the stability of the variables in the panel models, we will apply the natural logarithm transformation to all these variables. This requires having strictly positive values greater than zero. Therefore, data improvement was conducted in three stages.

In the first stage, we eliminated negative values for two variables: the Democracy and Freedom of Expression and Press Index (DFI) in 17 countries, covering all Arab countries under study, in addition to the Political Stability Index (PSI) in 11 Arab countries. This process involved adding the smallest negative value to all the data for each country, ensuring that the smallest value for the new data becomes zero. This method allows us to eliminate negative values without creating issues in the magnitude of changes over time for each country.

In the second stage, we addressed zero values by substituting them with the smallest possible non-zero value close to zero. Zero values were eliminated in the E-Government Development Index (EGDI) for two countries.

In the third and final stage, after eliminating negative and zero values in the previous two stages for all study data, we applied the natural logarithm transformation (denoted by LN) to all study variables.

After making the necessary adjustments to the study data, we proceed to test the stability of all variables constituting the study models. This is done relying on two tests, which are among the most common tests for detecting the presence or absence of unit roots in panel variables:

- Levin-Lin-Chu Unit-Root Test (2002)
- Im-Pesaran-Shin Unit-Root Test (2003)

These tests allow us to detect the presence or absence of unit roots in the variables under examination. In this stage, we conduct both tests simultaneously at a significance level of 5%. If the statistical value of the test exceeds the critical value, it indicates acceptance of the null hypothesis, implying that the variable is not stable. Conversely, if the statistical value of the test is smaller than the critical value, the alternative hypothesis is accepted, indicating stability of the variable.

Table 3. Results of Unit-Root Tests on Study Variables

Variable	Levin-Lin-Chu Unit-Root Test	Im-Pesaran-Shin Unit-Root Test	Decision
LN.CPI	7.698e-16	1.725e-10	Stable
LN.EGDI	< 2.2e-16	0.004449	Stable
LN.DP	< 2.2e-16	< 2.2e-16	Stable
LN.HDI	< 2.2e-16	1.699e-11	Stable
LN.RVI	< 2.2e-16	< 2.2e-16	Stable
LN.EXP	9.368e-13	5.406e-05	Stable
LN.DFI	0.000353	0.00741	Stable
LN.PSI	3.624e-08	0.0003367	Stable

Source: Prepared by the researcher based on R software

From Table 3, we can observe that all variables in both tests had statistical values smaller than the critical value at 5%. From this, we conclude that all variables are stable at a significance level of 5%.

7. Estimating the study model:

The panel data analysis approach relies on estimating three models: the pooled regression model, the fixed effects model, and the random effects model. Then, the best model among them is selected by conducting various tests to assist in this determination.

Based on the proposed study model, and using the R program, we obtained the summarized results in the following table:

Table 4. Results of Panel Data Models Estimation

Dependent Variable: LN.CPI		Pooled Regression Model	Fixed Effects Model	Random Effects Model
Explanatory Variables	Constant	3.5841909 (***)	-	4.3642652 (***)
	LN.EGDI	0.0473646 (***)	-0.0086543	-0.0083616
	LN.DP	-0.0791115	-0.0245947	-0.0108093
	LN.HDI	0.8744028 (***)	0.6411679 (*)	0.7711008 (**)
	LN.RVI	-0.0131725	-0.1062143 (**)	-0.0956141 (*)
	LN.EXP	0.1281616 (***)	0.0684320 (**)	0.0818294 (***)
	LN.DFI	0.0499757 (*)	-0.0428751 (*)	-0.0365717 (.)
	LN.PSI	0.2809699 (***)	0.0266745	0.0371526

Source: Prepared by the researcher based on R software

7.1. Individual and Time Effects Detection Tests:

After estimating the three models for panel data, we will conduct four tests to detect the presence or absence of individual and time effects. This is to compare between the pooled regression on one hand, and the fixed effects and random effects models on the other hand. For this purpose, we relied on the following tests:

- Lagrange Multiplier Test (Breusch-Pagan).

- Lagrange Multiplier Test (Gourieroux, Holly, and Monfort).
- Chow test for the poolability of the data.
- Fisher test.

The Lagrange Multiplier Test (Breusch-Pagan) and Lagrange Multiplier Test (Gourieroux, Holly, and Monfort) assess the possibility of individual and time effects in the study model. In other words, they study the optimal model choice between the pooled regression model on one hand, and the fixed effects and random effects models on the other hand. The null hypothesis for these tests suggests the absence of individual and time effects in the study model, meaning that the pooled regression model is the optimal model.

Similarly, the Chow test examines the hypothesis that the same parameters apply to each individual, i.e., the possibility of data pooling in the study model. The null hypothesis for this test suggests that the pooled regression model is an effective model.

As for the Fisher test, it compares between the pooled regression model and the fixed effects model to select the most consistent model between them. The null hypothesis for this test suggests that the pooled regression model is a consistent model.

Table 5. Results of Individual and Time Effects Detection Tests

Test Type	P-Value	Decision at 5% Significance Level
Lagrange Multiplier Test (Breusch-Pagan)	1.208e-15	Pooled regression model is not optimal
Lagrange Multiplier Test (Gourieroux, Holly, Monfort)	3.623e-16	Pooled regression model is not optimal
Chow test for the poolability of the data	5.087e-05	Pooled regression model is not effective
Fisher test	< 2.2e-16	Pooled regression model is not consistent

Source: Prepared by the researcher based on R software

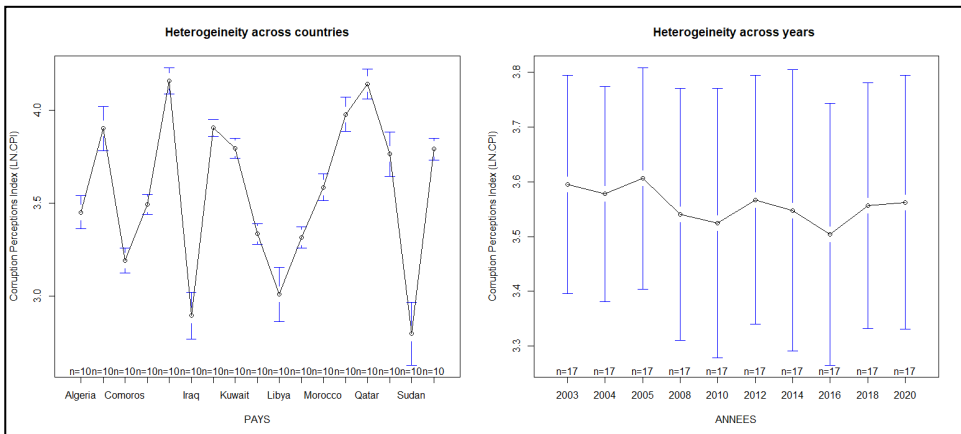
Based on the R program, we obtained a probability value lower than 5% in all four tests as shown in the previous table. This indicates the rejection of the null hypothesis and acceptance of the alternative hypothesis in all tests. Therefore, the pooled regression model in this study is deemed ineffective and inconsistent, and not the optimal model compared to both the fixed effects and random effects models.

As a conclusion of these tests conducted on the study model, the pooled regression model will be excluded, and both the fixed effects and random effects models will be selected.

7.2. Study of Heterogeneity:

Heterogeneity is a central topic in panel data analysis, as the individual and time variations have significant implications and lead to more accurate estimations. This is crucial to avoid biased estimations resulting from individual behavior homogeneity. Therefore, in this stage of our study, we will confirm the presence of heterogeneity among individuals and over the time, as it is highly beneficial and important.

Fig.4. Detection of Heterogeneity among Countries Over Time for the Corruption Perceptions Index (CPI) Indicator



Source: Prepared by the researcher based on R software

From Figure 4, we observe significant heterogeneity among countries and somewhat average heterogeneity across years for the main indicator of the study, which is the Corruption Perceptions Index (CPI). This is a positive observation and also indicates the substantial individual and time effects on the most important variable in the studied model. This confirms the previously obtained result regarding the ineffectiveness and inconsistency of the pooled regression model.

7.3. Comparison between Fixed Effects and Random Effects Models:

In this stage, we will compare between the fixed effects and random effects models using the Hausman Test. The null hypothesis of this test suggests that the random effects model is optimal.

Table 6. Results of the Test to Determine the Optimal Model between Fixed Effects and Random Effects Models

Test Type	P-Value	Decision at 5% Significance Level
Hausman Test	0.3435	Optimal Model: Random Effects Model

Source: Prepared by the researcher based on R software

The probability value is greater than 5% as shown in Table 6. This implies the acceptance of the null hypothesis and rejection of the alternative hypothesis. Therefore, the optimal model for the study is the random effects model.

7.4. Tests for Detecting Major Issues in the Standard Economic Model in the Estimated Model:

In this stage, we will ensure that the selected random effects model, chosen as the optimal model for the study, is free from major issues in the standard economic model, including:

- Linear correlation between variables (Interindividual correlation).
- Autocorrelation of errors.
- Heteroscedasticity.

Table 7. Results of Tests Detecting Major Problems in Econometrics in the Random Effects Model

Problem	Test Type	P-Value	Decision at 5% Significance Level
Linear correlation between variables	Breusch-Pagan LM test for cross-sectional	1.502e-09	There is a cross-sectional correlation between variables
Autocorrelation of errors	Breusch-Godfrey/Wooldridge test for serial correlation	1.698e-09	There is autocorrelation of errors
Heteroskedasticity	Breusch-Pagan test against heteroskedasticity	< 2.2e-16	There is heteroskedasticity

Source: Prepared by the researcher based on R software

From Table (7), we conclude that the random effects model contains several econometric problems. To address these issues, it is necessary to re-estimate the random effects model using the Feasible Generalized Least Squares (FGLS) method instead of the Feasible Generalized Least (FGL) method previously employed. (Refer to Appendix 02 on page 18).

7.5. Durbin-Watson Test for Selecting the Best Estimation Method for the Random Effects Model:

Given the results indicating the need to re-estimate the random effects model using the Feasible Generalized Least Squares (FGLS) method due to econometric problems, we will confirm this decision using the Durbin-Watson test, which is commonly used to choose between the two methods.

Table 8. Results of the Durbin-Watson Test for Selecting the Best Estimation Method

Test Type	P-Value	Decision at 5% Significance Level
Durbin-Watson test	1.277e-12	The best estimation method is Feasible Generalized Least Squares (FGLS)

Source: Prepared by the researcher based on R software

Based on the R program, we obtained a p-value smaller than 5% in Table (8), confirming that the best method for estimating the random effects model is the Feasible Generalized Least Squares (FGLS) method.

7.6. Re-estimation of the Random Effects Model:

After re-estimating the random effects model using the Feasible Generalized Least Squares (FGLS) method, the results are shown in Table (9).

Table 9. Results of Estimating the Random Effects Model using Feasible Generalized Least Squares (FGLS) method

Dependent Variable	LN.EGDI	LN.DP	LN.HDI
LN.CPI	0.0538668 (***)	-0.0975661 (***)	0.8675148 (***)
LN.RVI	LN.EXP	LN.DFI	LN.PSI
0.0012822	0.1216576 (***)	0.0397721 (***)	0.2716337 (***)

Source: Prepared by the researcher based on R software

7.7. Coefficient of determination of the estimated final model:

When estimating the model using the Feasible Generalized Least Squares (FGLS) method for random effects, we obtained a coefficient of determination equal to 77.28%, which significantly exceeds 50%. This indicates a high level of explanatory power for the independent variables included in the study model. Hence, it

confirms the strength and significance of the proposed and estimated model.

8. Study Results:

Based on the results obtained from estimating the model using the Feasible Generalized Least Squares (FGLS) method for random effects, we observe strong statistical significance for all independent variables, except for individual income level. From these findings, we draw the following conclusions:

- If the Digital Government Development Index (DGDI) increases by 10%, the Corruption Perceptions Index (CPI) for Arab countries will increase by 0.54%.
- If the government expenditure rate increases by 10%, the Corruption Perceptions Index (CPI) for Arab countries will decrease by 0.97%.
- If the Human Capital Index (HCI) increases by 10%, the Corruption Perceptions Index (CPI) for Arab countries will increase by 8.67%.
- If individual income level increases by 10%, the Corruption Perceptions Index (CPI) for Arab countries will increase by 0.01%.
- If the rate of exports of goods and services increases by 10%, the Corruption Perceptions Index (CPI) for Arab countries will increase by 1.21%.
- If the Democracy, Freedom of Expression, and Press Freedom Index increases by 10%, the Corruption Perceptions Index (CPI) for Arab countries will increase by 0.39%.
- If the Political Stability Index increases by 10%, the Corruption Perceptions Index (CPI) for Arab countries will increase by 2.72%.

Based on the above, we can conclude that the development and

enhancement of digital governance in Arab countries have a significantly positive impact on the Corruption Perceptions Index. This implies that the development of digital governance in Arab countries has a negative impact on corruption, contributing significantly to its reduction. This result suggests that the enhanced digital transformation of government in Arab countries and the development of digital government platforms have a direct and positive impact on reducing various forms of corruption, particularly administrative and financial corruption, that have several negative effects on the state, institutions, and individuals, such as hindering economic growth, reducing government revenues, and widening the gap between the rich and the poor. Herein lies the importance of digital governance in combating this negative phenomenon by increasing transparency and openness in the provision of government services, allowing for increased interaction between individuals and the government. All of this contributes to the fight against corruption.

In the same context, the mechanism through which digital governance contributes to the reduction of corruption relies on three main points: simplifying procedures, transparency, and accountability. The development of digital governance simplifies routine administrative procedures and increases the flow of data and information, facilitating the dissemination of reports and statistics and ensuring overall transparency. It also contributes to holding employees accountable by requiring them to submit regular reports on administrative work progress. Additionally, it enhances the effectiveness of the provided government services at lower costs and in less time. Digital governance facilitates individuals' access to these government services quickly and transparently, enabling individuals to directly access all officials and lodge complaints in case of corruption or bureaucracy. Furthermore, regarding transparency, the development of digital governance contributes to achieving transparency by providing all information related to decisions, procedures, and statistics related to

government services to everyone, individuals, and institutions alike. It also contributes to imposing regulatory rules and enforcing them on everyone without exception, thereby promoting equality for all. In this particular point, bureaucracy and all forms of corruption are narrowed down.

9. Conclusion:

Contributing to the reduction of corruption is one of the important tasks that require collaboration between the government and society. Digital governance can effectively contribute to this by providing an interactive, accessible, and user-friendly environment, enhancing transparency, responsiveness, and adopting unified policies, guidelines, and principles for all financial procedures and operations, and implementing adequate penalties for those who dare to engage in any form of corruption.

Our study primarily identified the nature of the relationship between digital governance and corruption in Arab countries. Therefore, we began our study by analyzing the Corruption Perceptions Index in Arab countries, then proceeded with the empirical study to examine the impact of digital governance on corruption in Arab countries using panel data models and the statistical software R.

9.1. Hypothesis verification::

Our study included two hypotheses that were tested to verify their validity. The results confirmed the validity of the hypotheses as follows:

- Arab countries, like other developing countries, witness a significant spread of corruption.
- Digital governance has a significant negative impact on corruption in Arab countries.

9.2. Study Findings:

The study yielded several important results, which can be summarized as follows:

- There is a significant positive and meaningful impact of digital governance development on the Corruption Perceptions Index in Arab countries. Specifically, if the Digital Government Development Index increases by 10%, the Corruption Perceptions Index for Arab countries will increase by 0.54%.
- This implies that the development and enhancement of digital governance in Arab countries have a significant negative impact on corruption, contributing significantly to its prevention and reduction. This result is logical and consistent with all previous studies we have referred to.
- Furthermore, the previous result is interpreted as digital governance contributing to the reduction of corruption in Arab countries through simplifying procedures, enhancing transparency, and promoting accountability.

9.3. Recommendations:

Based on our finding, the following recommendations can be made:

- Enhance the implementation of digital governance in all government institutions without exception.
- Develop a digital reporting system that allows citizens and users to report any type of corruption to the higher authorities of the government easily, quickly, and confidentially.
- Work on developing the infrastructure capable of meeting the requirements of modern digital governance.

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Appendices:

Oneway (individual) effect Within Model

Call:

plm(formula = MODEL, data = pdata, model = "within")

Balanced Panel: n = 17, T = 10, N = 170

Residuals:

Min.	1st Qu.	Median	3rd Qu.	Max.
-0.3490577	-0.0583256	0.0083541	0.0714970	0.2483762

Coefficients:

Estimate Std. Error t-value Pr(>|t|)

LN.EGDI	-0.0086543	0.0080048	-1.0811	0.281421
LN.DP	-0.0245947	0.0663494	-0.3707	0.711410
LN.HDI	0.6411679	0.2922333	2.1940	0.029815 *
LN.RVI	-0.1062143	0.0396146	-2.6812	0.008181 **
LN.EXP	0.0684320	0.0253767	2.6966	0.007828 **
LN.DFI	-0.0428751	0.0208056	-2.0607	0.041102 *
LN.PSI	0.0266745	0.0260269	1.0249	0.307114

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 2.6208

Residual Sum of Squares: 2.0992

R-Squared: 0.19905

Adj. R-Squared: 0.072874

F-statistic: 5.1834 on 7 and 146 DF, p-value: 2.7076e-05

Pooling Model

Call:

plm(formula = MODEL, data = pdata, model = "pooling")

Balanced Panel: n = 17, T = 10, N = 170

Residuals:

Min.	1st Qu.	Median	3rd Qu.	Max.
-0.568654	-0.142315	0.027514	0.131820	1.151170

Coefficients:

Estimate Std. Error t-value Pr(>|t|)

(Intercept)	3.5841909	0.3692088	9.7078	< 2.2e-16 ***
LN.EGDI	0.0473646	0.0097715	4.8472	2.912e-06 ***
LN.DP	-0.0791115	0.0538197	-1.4699	0.1435
LN.HDI	0.8744028	0.2061406	4.2418	3.719e-05 ***
LN.RVI	-0.0131725	0.0278234	-0.4734	0.6365
LN.EXP	0.1281616	0.0263231	4.8688	2.648e-06 ***
LN.DFI	0.0499757	0.0218221	2.2901	0.0233 *
LN.PSI	0.2809699	0.0294144	9.5521	< 2.2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 31.153

Residual Sum of Squares: 7.5495

R-Squared: 0.75767

Adj. R-Squared: 0.74719

F-statistic: 72.3567 on 7 and 162 DF, p-value: < 2.22e-16

Oneway (individual) effect Random Effect Model

Call:

plm(formula = MODEL, data = pdata, model = "random", random.method = "nlse")

Balanced Panel: n = 17, T = 10, N = 170

Residuals:

Min.	1st Qu.	Median	3rd Qu.	Max.
-0.352972	-0.071136	0.014907	0.075680	0.262379

Coefficients:

Estimate Std. Error z-value Pr(>|z|)

(Intercept)	4.3642652	0.5475591	7.9704	1.582e-15 ***
LN.EGDI	-0.0083616	0.0077723	-1.0758	0.282009
LN.DP	-0.0108093	0.0633747	-0.1706	0.864568
LN.HDI	0.7711008	0.2795512	2.7584	0.005809 **
LN.RVI	-0.0956141	0.0379631	-2.5186	0.011782 *
LN.EXP	0.0818294	0.0241469	3.3888	0.000702 ***
LN.DFI	-0.0365717	0.0202508	-1.8059	0.070928 .
LN.PSI	0.0371526	0.0254794	1.4581	0.144801

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 2.8301

Residual Sum of Squares: 2.277

R-Squared: 0.19543

Adj. R-Squared: 0.16066

Chisq: 39.3485 on 7 DF, p-value: 1.6769e-06

Oneway (time) effect Within FGLS model

Balanced Panel: n = 17, T = 10, N = 170

Residuals:

Min.	1st Qu.	Median	3rd Qu.	Max.
-0.51304277	-0.12610956	0.02651616	0.14233181	1.02885557

Coefficients:

Estimate Std. Error z-value Pr(>|z|)

LN.EGDI	0.0538668	0.0018161	29.6608	<2e-16 ***
LN.DP	-0.0975661	0.0043961	-22.1936	<2e-16 ***
LN.HDI	0.8675148	0.0242960	35.7061	<2e-16 ***
LN.RVI	0.0012822	0.0027579	0.4649	0.642
LN.EXP	0.1216576	0.0034238	35.5329	<2e-16 ***
LN.DFI	0.0397721	0.0039176	10.1522	<2e-16 ***
LN.PSI	0.2716337	0.0026944	100.8148	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 31.153

Residual Sum of Squares: 7.0761

Multiple R-squared: 0.77286

Lagrange Multiplier Test - two-ways effects (Breusch-Pagan) for balanced panels data: MODEL chisq = 68.699, df = 2, p-value = 1.208e-15 alternative hypothesis: significant effects
Lagrange Multiplier Test - two-ways effects (Gourieroux, Holly and Monfort) for balanced panels data: MODEL chibarsq = 68.683, df0 = 0.00, df1 = 1.00, df2 = 2.00, w0 = 0.25, w1 = 0.50, w2 = 0.25, p-value = 3.623e-16 alternative hypothesis: significant effects
F statistic data: MODEL F = 3.4339, df1 = 112, df2 = 34, p-value = 5.087e-05 alternative hypothesis: instability
F test for twoways effects data: MODEL F = 15.11, df1 = 25, df2 = 137, p-value < 2.2e-16 alternative hypothesis: significant effects
Hausman Test data: MODEL chisq = 7.8779, df = 7, p-value = 0.3435 alternative hypothesis: one model is inconsistent
Breusch-Pagan LM test for cross-sectional dependence in panels data: LN.CPI ~ LN.EGDI + LN.DP + LN.HDI + LN.RVI + LN.EXP + LN.DFI + LN.PSI chisq = 257.6, df = 136, p-value = 1.502e-09 alternative hypothesis: cross-sectional dependence
Breusch-Godfrey/Wooldridge test for serial correlation in panel models data: MODEL chisq = 61.737, df = 10, p-value = 1.698e-09 alternative hypothesis: serial correlation in idiosyncratic errors
Breusch-Pagan test data: MODEL BP = 323.37, df = 7, p-value < 2.2e-16
Durbin-Watson test for serial correlation in panel models data: MODEL DW = 0.96728, p-value = 1.277e-12 alternative hypothesis: serial correlation in idiosyncratic errors