


Research Article

Cross-sectional time series models for identifying the most important factors of e-government growth in Arab countries

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<http://creativecommons.org/licenses/by/4.0/>**ABSTRACT**

The goal of this study was to determine the key elements driving the expansion of e-government in Arab nations. One of the econometric models—the cross-sectional time series model (panel)—was employed to accomplish the intended outcome. The following techniques were used to estimate the models: fixed effects model, random effects model, and linear panel data regression analysis. The results revealed that e-government is negatively affected by political stability and the absence of terrorism and violence (PV), positively affected by government effectiveness (GE), positively affected by regulatory quality (RQ), and positively affected by the rule of law (RL).

Keywords: *e-government; e-governance; panel models*

1. INTRODUCTION

The developments in information and communication technology have brought about a major transformation in all work methods and performance activities, including the performance of government departments and public institutions, as they have deeply penetrated in a short period of time into all areas of social, economic and political life [11]. The concept of “e-government” has emerged in response to these advancements, aiding countries’ efforts to improve the services provided by the public sector [10]. Reform initiatives meant to lessen the inefficiencies brought on by bureaucratic constraints have frequently been linked to the adoption of information and communication technology (ICT) in public sector organizations [12]. ICT is used by government organizations to provide services and information to citizens, businesses, and other government organizations. E-government encourages government accountability and reduces the possibility of corruption by making government operations more transparent [13]. E-government opens new avenues for government reform and comprehensive governance, providing stakeholders with information and services that are more effective, accountable, and of higher quality while fostering stronger bonds among social actors [9]. Organizational and technological changes to the government are part of the development of e-government. In other words, e-government stresses the potential of digital transformation to reintegrate government agencies and overhaul outdated bureaucratic practices to better serve the public’s needs in a more thorough, adaptable, and agile manner [8]. E-government also emphasizes the use of ICT to improve government business processes. The usage of digital government and the contribution of new technologies to the field of e-government policies have been discussed since the early days of the Internet [6]. The investment in information technology has drawn criticism, especially in light of some countries’ economic hardships and the obstacles they face in offering their inhabitants high-quality social services [7]. Arab nations struggled to embrace e-government mechanisms, similar to other developed and emerging nations. The economic, social, and political characteristics of Arab nations differ, which could have an impact on how e-government is adopted and developed in each nation. This phenomenon has led us to investigate the factors influencing the growth of e-government in numerous Arab nations while accounting for the influence of time.



The functions and tasks of e-government have undergone significant changes due to rapid advancements in digital technologies such as the Internet of Things, artificial intelligence, and contemporary big data technologies. As a result, it is necessary to examine the effects of these changes over time. This study uses cross-sectional panel models that account for the time factor to investigate the key elements influencing the expansion of e-government in Arab nations.

2. RELATED WORKS

In this section, many works related to this study are reviewed.

Almasrite [10] provided a theoretical framework to define the notion of e-government and its significance, characteristics, advantages, phases of implementation, and challenges and investigated certain Arab and international e-government implementation experiences that Libya may utilize. The study employed an inductive approach, and some of its conclusions might help enterprises understand the significance of e-government implementation.

Zou et al. [8] examined the internal workings of the global e-government system that support better governance. Given that the real-world effects of e-government on enhancing governance need to be determined, the empirical test used data from 2010 to 2018 and 170 countries. The results of the linear panel data analysis revealed that the growth of e-government generally made it easier to strengthen governance. E-government affects several governance aspects differently. The four facets of governance—the rule of law, government effectiveness, regulatory excellence, and voice and accountability—are significantly improved by e-government, but its benefits for political stability, the absence of terrorism or violence, and the control of corruption are relatively weak. These results imply that there is still a gap between the ideal and practical use of e-government to improve governance overall.

Seiam and Salman [6] use a panel dataset that includes 110 nations from 2003 to 2021 to examine the relationship between corruption and electronic governance. In particular, the study looks at the relationship between the corruption perception index and the e-government development index, which is composed of four parts: the telecommunication infrastructure index, the online service index, the human capital index, and the e-participation index. A fixed effect model is a statistical method appropriate for panel data research that is used to empirically investigate these relationships. The study's findings indicate that levels of corruption in every country are significantly negatively correlated with the e-government development index, the online service index, the human capital index, and the telecommunication infrastructure index. Therefore, locations with high levels of e-government development, online service offerings, human capital, and telecommunications infrastructure could indicate low perceptions of corruption. However, there is no statistically significant association between the corruption perception index and the e-participation index.

Sharma et al. [5] determined the main obstacles that shared service centers (SSCs), e-government programs designed to improve simple and direct communication with the government and expand access to public services, must overcome. The study also aims to identify the hierarchical links among SSCs in rural India. A comprehensive review of the literature and a survey of SSC owners and specialists produced a list of 15 issues. Data on the challenges discovered were gathered and analyzed via interpretive structural modeling (ISM) and MICMAC-fuzzy MICMAC analysis. The challenges were then modeled hierarchically. On the basis of these findings, SSCs in rural India face several challenges, including “lower awareness” of e-government services, “longer travel time and transaction cost,” and “low level of digital literacy.” This report offers several suggestions to all parties involved in running SSCs to improve the provision of e-government services in rural India.

Durkiewicz and Janowski [4] confirmed the notion that performance metrics for digital and analog governments are comparable by employing four worldwide tools to assess governance: the World Bank's Worldwide Governance Indicators, the International IDEA's Global State of Democracy Index, the World Economic Forum's Network Readiness Index, and the United Nations' E-Government Survey. Although three WGI indicators (Government Effectiveness, Regulatory Quality, Voice and Accountability), three NRI indicators (Laws about IT, ICT use and government efficiency, and importance of ICT to government vision), and two indicators (civil society participation and direct democracy) were used to measure digital governance, two EGS indicators (Online Service Index and E-Participation Index) were used to measure analog governance. Except for the Global State of Democracy Index, which is from 2015, the data, which mostly comprises all 193 United Nations member nations, are from 2016. Eleven analog-digital pairs were selected for expected positive correlations on theoretical or conceptual grounds before the investigation began, and a range of correlation coefficients was calculated for each pair. The predicted correlations, including the strong positive relationships between digital indicators and analog measures of voice and accountability, government efficacy, and regulatory quality, are partially supported by the results. The study also revealed an unusually weak correlation between e-participation and the analog measures of civil society participation and direct democracy.

The article concludes with an analysis of the nature of analog-digital linkages and the development of reliable governance standards in the digital era.

The majority of earlier research concentrated on examining how e-government indicators—such as political stability, terrorism or violence, corruption, voice and accountability, government performance, organizational excellence, and the rule of law—affect e-governance indicators. The current study examines the degree to which e-governance influences e-government. In other words, the degree to which corruption, political stability, terrorism, and accountability in nations affect the growth of e-government. These factors may significantly impede the adoption and advancement of e-government. Additionally, the current study is different from earlier research in the study community, which included Arab nations.

3. CONCEPTUAL FRAMEWORK OF THE STUDY VARIABLES

The term “e-government” has no clear definition because of its administrative, technical, commercial, and social components. E-government has been defined differently by a number of international organizations. In 2002, the United Nations defined e-government as “the use of ICTs to more effectively and efficiently deliver government services to citizens and businesses” [3]. In 2003, “the OECD defined e-government as the use of information and communication technologies, and particularly the Internet, as a tool to achieve better government” [2].

The World Bank defines governance as “a country’s tradition and system of exercising power” [8].

Kaufmann et al. [1] defined the dimensions of governance as follows:

Voice and Accountability (VA): documenting opinions on freedom of expression, freedom of association, freedom of the press, and the extent to which a nation’s population can select its own government.

Political stability and the absence of terrorism and violence (PV): Assessing opinions on the possibility that the government would be overthrown or rendered unstable by the use of illegal or violent means, such as terrorism and violence with political intent. the ability of the government to create and implement sensible policies.

Government effectiveness (GE): assessing the creation and execution of policies, the legitimacy of the government’s adherence to these objectives, the efficacy of public services, and civil services’ independence from political interference.

Regulatory Quality (RQ): assessing how the general public views the government’s capacity to pass and implement sensible legislation and rules that allow and encourage the growth of the private sector. (c) The way the state and its citizens perceive the organizations that control their social and economic relationships.

Rule of law (RL): assessing the probability of violence and criminal activity and how much people follow and trust social norms, including the law, the courts, the police, and the standards of property rights.

Control of Corruption (CC): assessing the extent of elite and private sector “capture” of the state, as well as small- and large-scale corruption, and the use of public power for private benefit..

4. PROPOSED METHODOLOGY

Using a descriptive analytical approach, this study estimates cross-sectional time series via a panel model in the form of a fixed effect model or a random effect model. The two models are compared to determine which model is best, and the analysis is dependent on the E-views program. The historical approach will be adopted, where the research will be provided with in-depth information and data directly related to the research topic for the period studied from bulletins, reports and time series. Historical data will be obtained from the following sites: <https://www.worldbank.org/en/publication/worldwide-governance-indicators>

Given the data available for each variable, the study’s sample size is 21 countries, with a focus on Arab nations. For this model, the time periods are $T = [2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018, 2022]$, and $N = [1, 2, \dots, 21]$ is the number of national observation units in the collection. Below is a description of the variables, indicators, and data sources that were used in this study. The Eviews program was used for statistical analysis.

Independent variables: Voice and accountability, political stability and the lack of terrorism or violence, government effectiveness, regulatory quality, rule of law, and corruption control are the six comprehensive indicators comprise the e-government index employed in this study.

Dependent variables :The degree of e-government development was represented in the study by the E-government development index (EGDI). The EGDI falls between 0 and 1.

Ethical considerations: The data available at both of the abovementioned sites were used to achieve the desired goal.

Tools used in the study

For the study variables, several descriptive statistics, such as the arithmetic mean, standard deviation, and maximum and lowest values of the observations, were computed. Panel models were also relied upon owing to the nature of the data obtained.

Standard framework followed in the analysis

Cross-sectional time series models were created according to the following steps:

- Implementing the Hsiao test
- Studying the stability of cross-sectional time series
- Estimating cross-sectional time series models
- Selecting the appropriate model
- Verifying the model’s suitability
- Analyzing the results of estimating the appropriate model

5. RESULTS AND DISCUSSION

Table II: Descriptive statistics of the research variables

	CC	EGDI	GE	PV	RL	RQ	VA
Mean	-0.459248	0.397875	-0.533914	-0.704778	-0.515416	-0.570439	-1.110776
Median	-0.539500	0.374300	-0.446172	-0.571273	-0.594401	-0.454621	-1.039514
Maximum	1.400047	0.901000	1.451583	1.223599	0.980675	1.074331	0.303652
Minimum	-1.848734	0.000000	-2.440229	-3.280517	-2.590877	-2.547726	-2.208767
Std. Dev.	0.770548	0.210246	0.869185	1.083164	0.872231	0.917744	0.536252
Skewness	0.236723	0.155064	-0.032532	-0.414095	-0.311585	-0.199127	-0.120585
Kurtosis	2.306141	2.433797	2.244780	2.443180	2.161117	1.988490	2.463159
Jarque-Bera	6.791312	4.011363	5.530428	9.586005	10.51112	11.37443	3.333726
Probability	0.033519	0.134569	0.062963	0.008288	0.005218	0.003389	0.188838
Sum	-106.0863	91.90908	-123.3341	-162.8038	-119.0612	-131.7714	-256.5894
Sum Sq. Dev.	136.5610	10.16681	173.7609	269.8464	174.9809	193.7186	66.14021
Observations	231	231	231	231	231	231	231

Source: Prepared by the researcher on the basis of the results of the statistical program Eviews 10.

The EGDI series consists of 231 observations with an arithmetic mean estimated at (0.397875) with a maximum value of (0.901000) and a minimum value of (0.000), so these two values represent the highest and lowest values of the operating surplus during the period studied. The series bisects the median level (0.374300), and the series values are dispersed from their average with a standard deviation of (0.210246). In other words, Arab countries differ in terms of their EGDIs.

The Voice and Accountability series consists of 231 observations with an arithmetic mean estimated at (-1.110776) with a maximum value of (0.303652) and a minimum value of (-2.208767), so these two values represent the highest and lowest values of the operating surplus during the period studied. The series bisects the median level (-1.039514), and the series values are dispersed from their average with a standard deviation of (0.536252). In other words, Arab countries differ in terms of their voice and accountability indices.

The arithmetic mean of the 231 observations in the political stability and lack of violence series is estimated to be -0.704778, with a maximum value of 1.223599 and a minimum value of -3.280517. These two values indicate the highest and lowest operating surplus values during the period under study. With a standard deviation of 1.083164, the

series values are scattered from their average, and it bisects the median level (-0.571273). In other words, in terms of political stability and the absence of violence, Arab nations differ from one another.

These two values indicate the largest and lowest operational surplus values during the time under study. The Government Effectiveness series has 231 observations with an arithmetic mean estimated at (-0.533914), a maximum value of (1.451583), and a minimum value of (-2.440229). The series values are distributed from their average with a standard deviation of (0.869185), and the series bisects the median level (-0.446172). In other words, the effectiveness of governments varies across Arab nations.

The regulatory quality series consists of 231 observations with an arithmetic mean estimated at (-0.570439) with a maximum value of (1.074331) and a minimum value of (-2.547726), so these two values represent the highest and lowest values of the operating surplus during the period studied. The series bisects the median level (-0.454621), and the series values are dispersed from their average with a standard deviation of (0.917744). In other words, Arab countries differ in terms of their judicial quality.

The arithmetic mean of the 231 observations in the rule of law series is calculated to be -0.515416, with a maximum value of 0.980675 and a minimum value of -2.590877. These two values indicate the largest and lowest operational surplus values during the time under study. The series values are distributed from their average with a standard deviation of (0.872231), and the series bisects the median level (-0.594401). In other words, Arab nations differ in terms of their rules of law.

These two values indicate the highest and lowest operational surplus values during the time under study. The control of corruption series has 231 observations with an arithmetic mean estimated at -0.459248, a maximum value of (1.400047), and a minimum value of (-1.848734). The series bisects the median level (-0.539500), and the series values are dispersed from their average with a standard deviation of (0.770548). In other words, Arab countries differ in terms of their control of corruption indices.

- Independence test: For panel data, the Levin, Lin, and Chu test is applied. The variable is unsteady with respect to the null hypothesis.

Table II: Stability test results (Levin, Lin & Chu)

Decision	Probability	Statistic	Variable
Stable	,,0001	-3.74697	CC
Stable	,,0076	-2.42576	EGDI
Stable	,,0000	-4.08773	GE
Stable	,,0000	-3.94036	PV
Stable	,,0003	-3.80788	RL
Stable	,,0000	-3.27227	RQ
Stable	,,0000	-9.36091	VA

Source: Prepared by the researcher on the basis of the results of the statistical program (Eviews 10)

The test (Chu & Lin, Levin) is in line with the type and volume of data. The test's probability value for each of the study variables is less than 0.05, according to the test findings; thus, the null hypothesis of the test is rejected at a significance level of 5%, which indicates that all the variables are stable; therefore, the general least squares method can be used.

- Correlation matrix between the study variables: Table 3 shows the correlation matrix between the study variables

Table III. Matrix of correlations between the independent and dependent variables.

	CC	EGDI	GE	PV	RL	RQ	VA
CC	1	0.6362804473 019676	0.9208004319 479296	0.8430662259 349892	0.9264924573 641472	0.8860019151 163594	0.3994632752 906528
EGDI	0.6362804473 019676	1	0.7525191856 467101	0.4093445346 55163	0.7313192179 38331	0.7479193101 1078	0.3312193607 289108
GE	0.9208004319 479296	0.7525191856 467101	1	0.7425023220 239062	0.9385844428 869005	0.9387655514 86942	0.4273694706 709918

PV	0.8430662259 349892	0.4093445346 55163	0.7425023220 239062	1	0.8183413968 662544	0.7308817474 396144	0.3529751056 22103
RL	0.9264924573 641472	0.7313192179 38331	0.9385844428 869005	0.8183413968 662544	1	0.9347700508 722749	0.4677599455 095885
RQ	0.8860019151 163594	0.7479193101 1078	0.9387655514 86942	0.7308817474 396144	0.9347700508 722749	1	0.4942380643 07877
VA	0.3994632752 906528	0.3312193607 289108	0.4273694706 709918	0.3529751056 22103	0.4677599455 095885	0.4942380643 07877	1

Source: Prepared by the researcher on the basis of the results of the statistical program (Eviews 10)

Panel Data Analysis Methodology: The models were estimated via the following methods:

Linear panel data regression analysis

- Fixed Effects Model
- Random effects model

Table IV shows how the e-government index is affected by e-governance metrics.

Table IV: Effect of e-governance indicators on the e-government index

Estimation method						Explanatory variables	Dependent Variable
p-value	Regression Pooled	p-value	Random effects	p-value	Fixed effects		
0.0000	0.459333	0.0000	0.459333	0.0000	0.474653	C	EGDI
0.1007	-0.056841	0.0219	-0.056841	0.7493	-0.007978	CC	
0.0039	0.100982	0.0001	0.100982	0.0017	0.079047	GE	
0.0000	-0.090638	0.0000	-0.090638	0.0000	-0.079923	PV	
0.0000	0.172990	0.0000	0.172990	0.0000	0.146086	RL	
0.0660	0.054207	0.0103	0.054207	0.0072	0.057201	RQ	
0.2455	-0.020308	0.1044	-0.020308	0.3382	-0.012027	VA	
0.666417		0.666417		0.829836		Adjusted R-squared	
0.121431		0.121431		0.086729		S.E. of regression	
		77.58062		71.10228		F-statistic	
		0.000000		0.000000		Prob(F-statistic)	
		222.192485				Hausman Test Chi-Sq. Statistic	
		0.0000				Prob Chi-Square	
		۲۳۱				N° of Observation	

Source: Prepared by the researcher on the basis of the results of the statistical program (Eviews 10)

On the basis of the findings of the Hausman test and Table 4, the following conclusions can be drawn:

Given the probability value (0.000), which is less than 0.05, and the chi-square value (222.192485), the fixed effects model is the most appropriate and successful model for measuring the impact of governance indicators on e-government.

The value of the coefficient of determination (Square-R) for the fixed-effects regression model is equal to 0.829836, which means that the variables related to the governance indicators together affect e-government and that these variables explain 82.984% of the change in the e-government indicator.

Voice and accountability (VA) negatively affect e-government, as the value of the impact coefficient (-0.012027) is not statistically significant at a level of 0.05, as the probability value (0.3382) is greater than 0.05.

Political stability and a lack of terrorism and violence (PV) adversely influence e-government, as evidenced by an effect coefficient of -0.079923 , which attained statistical significance at the 0.05 level, with a probability value of 0.0000, falling below 0.05.

Government effectiveness (GE) positively influences e-government, as evidenced by an impact coefficient of 0.079047, which achieves statistical significance at the 0.05 level, with a probability value of 0.0017 exceeding 0.05.

Regulatory quality (RQ) has a positive effect on e-government, as evidenced by an impact coefficient of 0.057201, which is statistically significant at the 0.05 level, with a probability value of 0.0072, falling below the threshold of 0.05.

The rule of law (RL) favorably influences e-government, as evidenced by an effect coefficient of 0.146086, which attained statistical significance at the 0.05 level, with a probability value of 0.000, falling below 0.05.

Control of corruption (CC) adversely influences e-government because the impact coefficient (-0.007978) is not statistically significant at the 0.05 level, with a probability value (0.7493) exceeding 0.05.

Therefore, the equation by which government indicators affect the e-government index can be written as follows:

$$EGDI = 0.474653 - 0.007978 cc + 0.079047GE - 0.079923PV + 0.146086RL + 0.057201RQ - 0.012027VA$$

6. CONCLUSION

E-government represents a competitive domain in which governments strive to acquire information and communication technology. This study utilized the e-government development index to analyze the factors affecting e-government in Arab countries. Indicators of e-governance, including voice and accountability, political stability, absence of terrorism or violence, governmental efficacy, regulatory quality, rule of law, and corruption control, were also employed. Panel models, which incorporate temporal dynamics, were utilized to measure the variation in e-government development across Arab countries. The optimal model was selected via a comparative analysis of the existing models.

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