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E-Governance for Sustainable Development in MENA Countries

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Abstract

This research paper investigates the role of electronic governance on various aspects of economic and social development in the Middle East and North Africa (MENA) region. The paper uses a panel data of 15 MENA countries between 2003 and 2018. The paper examines, first, the effect of e-government on good governance. Second, it highlights the effect of good governance on sustainable development and third, it assesses the effect of e-government development on sustainable development. The paper points out some challenges that prevent MENA countries to benefit from ICTs in their development strategies and proposes some policy recommendations.

Keywords: *E-governance; Good governance; Sustainable development; MENA countries.*

JEL classification: H11; H41; O10.

1. Introduction

Nowadays, good governance has considerable potential for modernizing public administration, improving public service delivery, dealing with increasingly more complex development imperatives, and promoting well-being. It may contribute to the fulfillment of the 2030 Sustainable Development Goals (SDGs) set by the United Nations. In that regard, digitalization to support governance strategies remains an important driving force for realizing this transition. It presents incredible opportunities to innovate, strengthen and improve the ways of working and creates plenty of advantages. Indeed, in order to seek the economic, social and environmental need's sustainability, it is necessary to establish both good governance and electronic government strategies by identifying the mechanisms, processes, and outcomes (Dhaoui, 2019a). A question that may emerge here is how improvements in electronic government and good governance can contribute to sustainable development, and also how digital technologies can enhance good governance.

Digitalization has underpinned every aspect of our daily life. Information and communication technologies (ICTs) have enabled countries to develop electronic governance (E-GOV) initiatives that have changed how citizens interact with their governments, creating an important development in their expectations (Dodd, 2000). E-governance involves the use of ICTs to transform the workings of government organizations and their relationship with citizens, businesses and other arms of governments. E-governance is introduced as a means to reduce costs, improve services for citizens and increase the effectiveness and efficiency of the public sector (Signore *et al.*, 2005). Over the past decades, developing countries have made efforts to leverage ICTs as drivers of efficiency gains and enhance public sector performance. While governments intend to achieve the objectives of sustainable development at various level (economic, social environmental and so on) through the working system of the economy mainly through the development of institutions, there is further opportunities and contention also that government strategies may result into inefficiency, all depend on the reform success and the advances in accountability (Hauner & Kyobe, 2010).

Despite all these debates, the arguments of whether the electronic government and good governance contribute positively to various aspects of sustainable development have become an accepted premise in most economies world over. To achieve broader policy objectives, MENA countries have made efforts to leverage ICTs over the past decade. However, digital government efforts are still perceived as technical support activities and not as a core strategic

component of public sector activities (OECD, 2017). The alternative is that E-governance should be value-driven and not technology-driven.

This paper analyses the impacts of good government on the sustainable development of MENA countries. The paper also analyses whether electronic governance is a catalyst for boosting the impact of good governance. Thus, this paper attempts to answer the following three research questions:

(i) What are the impacts of electronic governance on good governance of MENA countries?

(ii) What are the impacts of good governance on the sustainable development of the region?

(iii) Does electronic government improvements accelerate the impacts on various aspects of sustainable development of MENA countries?

The primary concern of the present paper is to obtain empirical evidence and to increase the level of awareness in relation to electronic governance and good governance and their contribution to sustainable development in a sample of 17 MENA countries over the period span 2003-2018. The specific objectives are threefold: First to assess the effect of e-governance on good governance and sustainable development in MENA countries; second to identify key success factors which make the difference in e-governance development among MENA countries, and third to suggest relevant policy recommendations on e-governance development for sustainable development in MENA countries.

The paper utilizes comparative analysis and advanced econometric measures such as Ordinary Least Square, Fixed Effects, and Random Effects models to answer the three questions and accomplish its objectives. The empirical results from this investigation may be useful as follows; first, they offer an assessment for electronic governance and good governance and their impacts on economic, social and environmental development. Second, empirical findings bring attention with regard to the importance of ICTs improvements towards accelerating the impacts of good governance on sustainable development.

Following the introductory motive, the remainder of this paper is set out as follows. Section 2 discusses the literature review focusing on electronic governance, good governance efficiency and sustainable development relationships. Data and methodology which are used by this paper to answer the three stated research questions and fulfill the intended objectives are

presented in Section 3. While Section 4 deals with empirical results; Section 5 offers conclusion and policy implications.

2. Insight from literature review

Electronic Governance (EGOV) refers to the whole system involved in managing the society (Grönlund *et al.*, 2005). EGOV is the application of information and communication technology (ICT) by the government to transform itself and its interactions with customers in order to create an impact on society (Estevez & Janowski, 2013). Electronic governance for sustainable development (EGOV4SD) is the use of ICT to support public service, public administration and the interaction between government and the public while enabling public participation in government decision-making, promoting social equity and socio-economic development and protecting natural resources for future generations (Estevez & Janowski, 2013).

Good governance refers to the management of government in a manner that is essentially free of abuse and corruption, with due regard for the rule of law and respect of people's rights to be engaged in public affairs. Mira & Hammadache (2017) define good governance as the quality management and orientation of development policies is assumed by many economists, having a positive influence on economic performance.

The following discussions present some past studies which examine the relationships between electronic governance (EGOV), good governance (GGOV) and sustainable development (SD). However, these studies overlooked the connotation of modeling nexus effects between the three dimensions while analyzing impact relationships, thus attracting partial analysis.

According to Gordon (2002), e-governance is the use of ICTs (Blockchain, Robotics, Internet of Things, Artificial Intelligence, Big Data, etc.) to improve the process of government. In a narrow sense it is sometimes defined as citizen's services, re-engineering with technology, or procurement over the Internet (Signore *et al.*, 2005).

For Spremić *et al.* (2009), e-governance is the use of information technologies and the Internet for better delivery of government services to citizens. Marthandan & Tang (2010) spread out the concept by focusing on the features of interactions between economic, political and social actors. Indeed, e-governance allows the government, citizens, businesses, and customers to work more efficiently. The linkages between government and citizens (B2C), Government and businesses (G2B), businesses with each other (B2B), and businesses and

customers (B2C) would be easier and with low cost (Dhaoui, 2019b) and service elapsed time decrease.

As regards the effect of electronic governance on good governance, governance is perceived by international development agencies as a key policy priority and a crucial element of the good governance agenda (Madon, 2009). Indeed, UNESCO (2005) points out that with a performing electronic governance both the process of disseminating the information to the public and other agencies and the administrative activities will be efficient, speedy and transparent. In other words, the electronic governance may increase government accountability. Kettani & Moulin (2014) argue that e-governance makes the government more efficient, responsive, transparent and legitimate.

Thus, e-governance is not just a bridge between various agents. It embodies new concepts of citizenship, both in terms of citizen's needs and responsibilities. ICTs have many features such as high quality and cost-effective government operations, public service improvements, citizen engagement, and more successful administrative and institutional reforms.

For many decades, the concept of sustainable development has become a topic of discussion at the international level. Sustainable development is the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UNWCED, 1987)." The objectives of sustainable development include, among other, stable and long term economic growth, social development (education, health, etc.), preservation of the environment, etc. Current development challenges are more complex. Indeed, and according to the SDGs Agenda, sustainable development should concern economic, social and environmental dimensions (Dhaoui, 2019a; UNDP, 2014).

The Sustainable Development Goals framework emphasizes the key role of effective, accountable institutions for all and Goal 16 is dedicated to it (promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at levels). Important aspects of institutional development are largely rooted in the targets of several of the other 16 goals. Since the past decades, many countries have modernized their institutions and decision making process in order to make the transition to the market economy, especially by the end of the Cold War (Hout, 2007). The increase in the level of external debt pushed many developing countries to launch structural adjustment and upgrading programs, including their governance systems. The accelerated globalization and the unregulated market is also another reason for the

emergence of good governance framework (Craig & Porter, 2006). Good governance can be defined as “a set of qualitative characteristics relating to processes of rulemaking and their institutional foundations. It encapsulates values such as enhanced participation, transparency, accountability, and public access to information. Also, it also helps to combat corruption and secures both basic human rights and the rule of law” (UNU-IAS, 2015).

As regards the contribution of good governance to sustainable development, large bodies of studies have talked about this nexus and empirical results differ according to the countries or region and according to the econometric methods. Some studies show a non-conclusive link. Other studies demonstrate a negative link. However, the majority of empirical works prove a positive and direct effect of good governance to achieve sustainable development objectives such as reducing poverty, improvement of health outcomes, more equitable redistribution of income, environment sustainability, institution accountability, and so on (Shylendra & Bhardikar, 2005; Kioe Sheng, 2010).

According to Jukneviene & Kruteivaite (2012), accountable institutions can help citizens to achieve sustainability by providing equal opportunities and contribute heavily to the maintenance of human rights, environmental protection, stable macroeconomic conditions, health conditions improvement, and a good management and mobilization of resource for essential public services. West *et al.*, (2009) contribute to the establishment of an appropriate public policy.

The aim of e-governance is mainly to provide better services to citizens in an efficient way and thus to facilitate the achievement of sustainability at various levels. Thus, the strategies of e-governance development should be value-driven instead of technology-driven since benefits from e-governance do not take place by digitizing and placing it online.

Lim (2014) examines the effects of e-governance on good governance and on sustainable development for a sample of 22 countries in SIDS using comparative analysis and econometric modeling. He found a positive and significant impact of e-governance on good governance. Concerning the impact of good governance on sustainable development, he also found a significant link.

Although significant efforts have been dedicated to e-governance and sustainable development individually, research at the intersection of these domains is scarce (Esteve *et*

al., 2013). Thus, systematic e-governance for a sustainable development research framework is yet to emerge.

Esteve *et al.*, (2013) present an empirical analysis of 10 case studies of e-governance for sustainable development including context, problems addressed and solutions applied. The most common sustainable development problems addressed are empowerment (social), business opportunities (economic), man-made activity (environmental) and capacity-building (institutional). Their findings reveal that EGOV4SD intuitive contributes to a variety of SD goals with a clear difference between countries. In developed countries such as Singapore and Hong Kong, the efforts are in re-provisioning the second-generation ICT government infrastructure relying upon cloud services and green IT technologies to enable ecosystem-based service delivery. The case studies for developing countries such as India and Rwanda the efforts aimed at delivering concrete services to rural populations.

To clearly show the conceptual framework of EGOV4SD, Esteve *et al.*, (2013) define a matrix between four dimensions of its problem domain and five dimension of its solution domain. The cell of the matrix characterize the contribution space, matching problems and solutions across dimensions

Table 1. EGOV4SD conceptual framework

			EGOV				
			Government	Technology	Interaction	Customer	Society
			Solution Space				
SD	Social	Problem Space	Contribution Space				
	Environmental						
	Economic						
	Institutional						

Source: Esteve et al, (2013), the Proceedings of the 14th Annual Conference on Digital Government Research, p.93.

Esteve *et al.*, (2013) point out that the relations are asymmetric in the sense that one domain (solution domain) helps fulfill the goals of another domain (problem domain). It is worth noticing that SD is a problem at any relation. As for ICT, it is always a solution domain while GOV is a problem in relation to ICT and a service domain in relation to SD. When taking into account EGO4SD, SD is the problem domain and EGOV is the solution domain.

Some studies show that many e-governance projects implemented in some countries have not resulted in significant improvements in citizen services and welfare (Benjamin, 2001; Gartner Group, 2002; Heeks, 2003, 2006; Kanungo, 2003; UNDESA, 2003). Madon (2009) argues that the low usage of e-governance leads to a lack of equity in providing access to e-governance applications.

The linkage between e-governance and corruption at the country/state level has been addressed by relatively few papers (e.g., Mahmood 2004; Andersen & Rand; 2005; Pathak *et al.*, 2007). Ojha *et al.* (2008) point out that, from the available studies, it appears that if e-government readiness index (or proxies of citizen' access to ICT) is taken as the independent variable, then e-governance would appear to exert a negative effect on corruption. however, if a variable or index reflecting e-governance development/ maturity is chosen as the independent variable, then it appears that e-governance may have very little or no influence on corruption.

3. Data and Methodology

This section of the paper discusses data and the methodology which is applied by this paper to analyze the impacts of e-governance and good governance on the sustainable development of 15 selected countries of the MENA region.

3.1. Data and variable description

This paper uses panel data of the following MENA countries: Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey, and United Arab Emirates. The time span covers the period from 2003 to 2018. Libya, Syria, and Yemen are not incorporated in this analysis because of their war-stricken nature. Therefore, this analysis covers the 15 countries in the MENA region. This paper uses panel data because they have more variability and allow to explore more issues than do the cross-sectional or time-series data alone (Kennedy, 2008). They give more informative data, more variability, less colinearity among the variables, more degrees of freedom and more efficiency, as argued by Baltagi (2001) and capable to surmount the problem of endogeneity (Baltagi 2001, Hsiao 2003). The time span 2003-2018 is preferred because data for e-governance are obtained sequentially from 2003.

As we mentioned, the paper seeks to explore the impacts of relationships between three main variables: E-governance, good government and sustainable development. The e-governance is

highlighted through four key variables which are: ICTs infrastructure (TII), ability to use E-government (HII), e-services infrastructure (OSI), and e-participation index (EPI). The UN e-governance survey on “e-government in support of sustainable development” offers a snapshot of trends in the development of e-governance in many countries. The E-governance readiness index (EDGI) is calculated as below:

$$EDGI = 1/3(OSI \text{ normalized} + TII \text{ normalized} + HCI \text{ normalized})$$

Data for these variables are available for the years 2003, 2004, 2005, 2008, 2010, 2012, 2014, 2016, and 2018. Due to the importance of these variables in our analysis and also because these variables have a linear trend (either increasing or decreasing), we replace missing data by linear interpolation method.

Good governance is highlighted through three variables: government transparency and government effectiveness (Goveff), control of corruption (CoC) and regulatory quality (RQ). Sustainable development encompasses four dimensions: economic development, social development, environmental management, and disaster management. Data for these variables come from the World Bank Worldwide Governance Indicators (WGI).

The GDP per capita, constant 2010, USD, (GDPC) is used as a measurement of economic development. The social development is examined through three variables which are political stability and absence of violence (PS&AV), Health index (HI), and under five mortality rate (UFM).

Life expectancy at birth expressed as an index using a minimum value of 20 years and a maximum value of 85 years. The indicator score for each unit is standardized as below:

$I^s = \frac{I - \min(I)}{\max(I) - \min(I)}$, where I is the value of life expectancy at birth for a unit, $\max(I)$ is a maximum value of I over a unit, $\min(I)$ is the minimum value of I over a unit minus a small value. Data for GDPC, PS&AV, UFM, and HI come from the World Bank data portal (WDI).

Other dimensions of sustainable development include ecosystem vitality (EV) to measure environment management and vulnerability (VUL) to natural disasters as a measurement of natural disaster management. The data source for the EV variable is the Environmental Performance Index Report led by the Yale Center for Environmental Law & Policy (YCELP) and other organizations. The data source for the VUL variable is the World Risk report (Alliance Development Works and UNU-EHS).

We use also four control variables covering four areas such as democracy, social condition, interaction variable, and measurement method. For democracy, we use Voice and Accountability (VA) to show the extent to which a country's citizens are able to participate in selecting their government and also to measure freedom of expression, association, and a free media. Data for this variable come from the WDI dataset. For social conditions, we use the size of the population (POP). Also, the interaction between Voice and Accountability (VA) and the environmental performance Index (EPI) is also employed as an interaction variable. Finally, it is worth noticing that the UN-E-government survey for 2014 changed the components of the human capital index (HCI) by adding expected years of education and means years of schooling to the index. For this reason, we add a measurement method related control variable which is a dummy variable (HCIND) that takes the value zero for the observation 2003-2013 and the value one for the 2014-2018 time span.

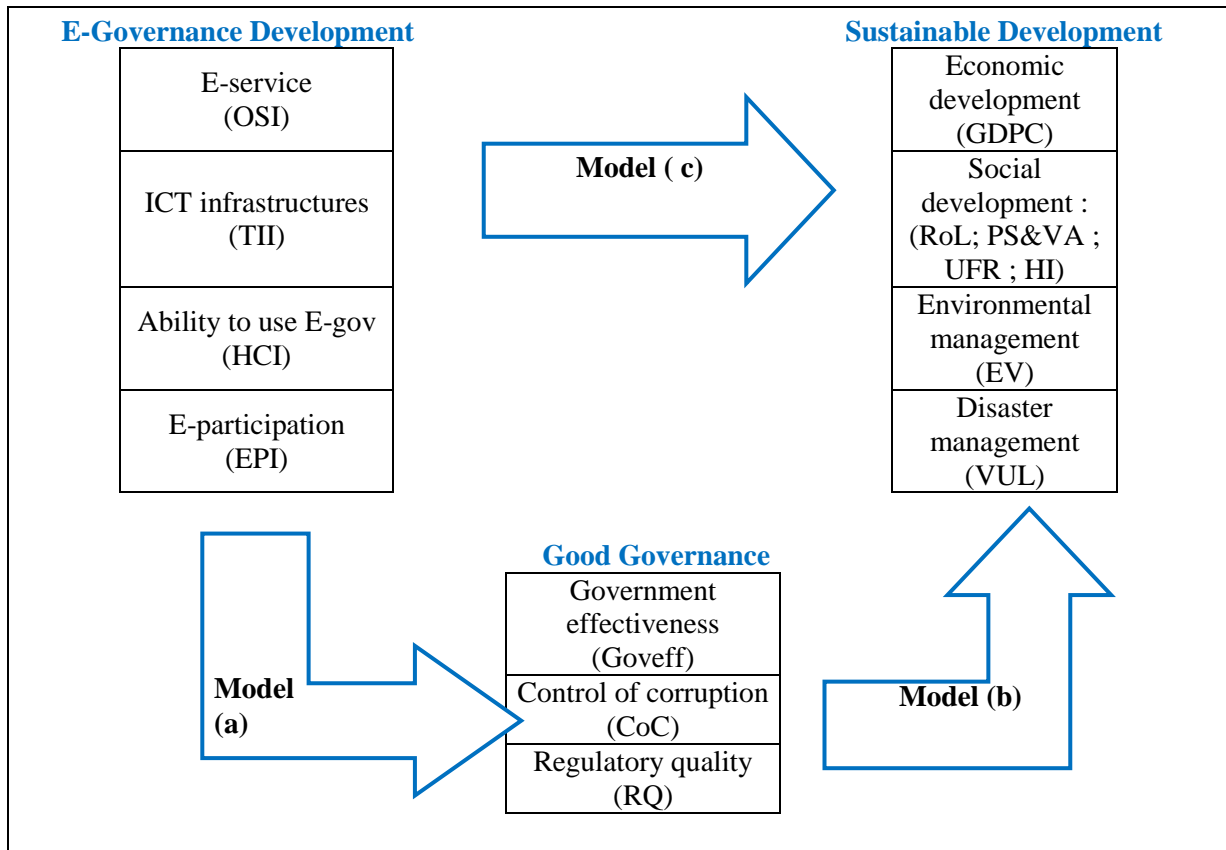
More detailed about variables and their components or sub-components used in this research paper are detailed in *Appendix 1*.

3.2. Empirical model specification

To the best of our knowledge, there are few papers in MENA countries which examine electronic governance while analyzing the impacts of good governance on various aspect of sustainable development. In addition, sustainable development is highlighted through many dimensions such as GDP per capita, health indicators, environmental and disaster management.

To examine the various impacts relationship, the paper uses econometric modeling and comparatives analysis methods. The approaches implemented here are inspired by the study of Lim (2014) of SIDS countries. The econometric approach is based on three main models. Model (a) tries to examine the effect of e-governance on good governance. Model (b) examines the effects of good governance on sustainable development, while Model (c) looks at the effect of E-governance on sustainable development. Our research design can be summarized in the below graph:

Fig 1. Research design



The general expression of a panel data model is as below:

$$y_{it} = \alpha_{it} + \beta X_{it} + \varepsilon_{it}, \quad i = 1, \dots, n, t = 1, \dots, T$$

The Pooled Model is:

$$y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}, \quad E(\varepsilon|X) = 0$$

The estimation method for Pooled Model is the Ordinary Least Square Method (OLS)

Now, we assume heterogeneity

$$E(\varepsilon_{it} | \alpha_i, x_{i1}, \dots, x_{iT}) = 0, \quad t = 1, \dots, T$$

For the Random Effect model (RE), α_i (individual effect) is random variable and uncorrelated with x_{it} :

$$y_{it} = \alpha_i + \beta X_{it} + \varepsilon_{it}$$

The pooled OLS works well for RE models.

For the Fixed Effect model (FE), α_i is random variable and correlated with x_{it} :

$$y_{it} = \alpha_i + \beta X_{it} + \varepsilon_{it}$$

The pooled OLS is inconsistent for FE and does not work well for works well for RE models

The guideline of model selection is based on F-test, M-test and Hausman test (Park, 2011; Wooldrige, 2013). The results of these tests are reported in *Appendix 3*.

We use the F-test (Fisher test) to compare the FE model and the Pooled OLS model. F-test gives an indication of goodness of fit. The null hypothesis is that all dummy parameters except for one for the dropped are a zero ($\mu_1 = \dots = \mu_{n-1} = 0$). If the null hypothesis is rejected (an increase of goodness of fit), FE mode is better than Pooled OLS.

We use LM-test (Lagrange Multiplier test) to contrast the RE model to the Pooled OLS model. The null hypothesis is that individual (or time) specific variance is zero ($\delta^2 = 0$). If the null hypothesis is rejected RE mode is able to deal with heterogeneity better than the Pooled OLS.

The Hausman test is employed to test the similarity between FE and RE models. The null hypothesis is that individual effects are uncorrelated with any regressor in the model. We conducted a Hausman test when both hypotheses of the F-test and LM-test are all rejected. If the null hypothesis of non-correlation between an individual effect and regressors is rejected, we choose the FE model; otherwise, the RE model would be preferred.

After the econometric modeling, we will conduct a comparative analysis. We focus on 2018 as a benchmarking year. First, we analyze a scatter plot of the E-government readiness index (EDGI) and GDP per capita to show whether the correlation between the two variables is positive or negative, has a linear or exponential tendency. Second, based on the mentioned scatter we divide the sample countries into groups and for each group, we put its performance in good governance (CoC, Goveff, and RQ) and in sustainable development (GDPC, RoL, PS&AVT, UFM; HI, HI, EV, and VUL). For each variable, we calculate the average. For each country, we count the number of good performances. We assume that “good performance” acquire when a country’ index in a variable is equal or exceed the average and it is not negative. Third, we plot a scatter of EDGI and a number of good performances in good governance and sustainable development to show the sign and tendency of the relationship and to check whether the country grouping still the same. Finally, we will try to study what makes the difference between the groups.

As for the expected results and policy implications, first, for the effect of e-governance on good governance, we expect that e-governance development has a significant impact on the majority of good governance indicators. Second, for the effect of good governance on

sustainable development, we expect that good governance will have a positive and significant effect on the majority of the sustainable development dimensions. Third for the effect of e-governance development on sustainable development we expect that the improvement of e-governance will significantly affect various indicators of sustainable development.

In accordance with the expected data analysis and the possible outcome of the theory and the questions raised, the major expected result is to translate the research's objectives to particular knowledge, commitment and actions. Indeed, the paper is to be considered as a feasibility study to better understand special challenges and opportunities of digital governance for various aspects of sustainable development and resilient societies in MENA region. An additional result is to generate valuable outputs to ascertain and recognize governance-based digital as one of the most underpinnings of good governance mechanism.

4. Empirical results

In the MENA region, the level of achievement of SDGs, governance system performance, and the investment in advanced technologies and solutions are different from one county to another, including sometimes within the same state.

As regards the economic performance, the MENA region witnessed lower annual growth rates in output, compared to many other developing regions in the World (World Bank, 2014). Some countries in the MENA region have made remarkable progress in many development goals, especially in the area of education and health. However, there are certain aspects of human development in which MENA countries have not progressed as far such high level of unemployment, widespread inequality, environmental degradation, etc. (Dhaoui, 2019c).

The Human development index (HDI) for the MENA region was 0.699 in 2018, compared to 0.771 for Europe and Central Asia and to 0.535 for sub-Saharan Africa. In general, MENA countries are ranked among countries with intermediate levels of development. The index is lower than its global counterpart at the world level which was 0.728 in 2018. As regard to e-governance, the MENA countries are characterized by large public sectors and a complex regulatory structure and regulations.

The implementation of ICTs to modernize public institutions has emerged and is growing. However, divides seem to be limited. Also, digital and data skills are still scarce and unevenly disrupted across territories. The budgetary constraint is another challenge for the implementation of digital government strategies (OECD, 2017). Concerning Governance

system performance, there is a substantial cross-country variance in the related indicators, as well as variance in the responses to each of the indicators for individual countries.

The issue now is how e-governance initiatives can help MENA countries achieve better results in their governance and therefore their development policy goals. To go deeper into the analysis, we present a brief stylized fact with reference to our sample countries.

Table 2 presents a short description of data expected to estimate results in both econometric and comparatives analysis. The benchmarking year here is 2018.

Table 2: Descriptive statistics of variables (2018)

	Variable	Mean	Std.dev	Coef of var.	Min	Max
Measures E-governance Development	EDGI	0.620	0.141	22.7%	0.337	0.829
	OSI	0.663	0.214	32.3%	0.215	0.944
	TII	0.514	0.192	37.4%	0.184	0.856
	HCI	0.684	0.089	13.0%	0.509	0.814
	EPI	0.643	0.211	32.8%	0.202	0.943
Measures on Good Governance	CoC	-0.206	0.683	331.6%	-1.399	1.151
	Goveff	-0.063	0.627	995.2%	-1.320	1.431
	PS&AV	-0.638	0.928	145.5%	-2.555	0.743
	RQ	-0.232	0.680	293.1%	-1.296	0.931
	RoL	-0.121	0.682	563.6%	-1.759	0.806
	VA	-0.935	0.452	48.3%	-1.644	0.210
Measures on Economic and Social Development	LGDP	9.236	1.007	10.9%	7.974	11.054
	HI	0.863	0.038	4.4%	0.776	0.924
	UFM	13.820	6.941	50.2%	6.800	26.700
	CEPI	0.583	0.059	10.1%	0.432	0.678
	EV	0.482	0.090	18.7%	0.310	0.635
	VUL	41.872	6.451	15.4%	31.510	56.550
	IPOP	16.568	1.325	8.0%	14.266	18.404

Source: sorted by the author.

The coefficient of variation of good governance variables is higher when considering the good governance measures than the e-governance' measures and to a lesser extent the variables of economic and social development, except the under-five mortality rate variable. A higher value of the coefficient of variation means a greater the dispersion around the mean, especially for government effectiveness, rule of law, and control of corruption.

On average, the E-Government Development Index (EDGI) in 2018 is 0.620 for the sample countries, compared to 0.773 for Europe and to 0.578 for Asia. The EDGI score was 0.384 in 2003 and 0.465 in 2010 for the sample countries in our analysis. The lowest value is registered in Iraq (0.337), while the highest value (0.830) is in the United Arab Emirates (UAE). The e-participation index (EPI) is 0.643 in 2018, compared to 0.086 in 2003 and 0.202 in 2010. The average score of control of corruption for MENA countries is -0.206. The

lowest score is registered in Iraq (-1.399), while the highest value is in UAE (1.152). The worst performance of the region, on average, is registered for the variables voice and accountability, and political stability and absence of violence. The health index remains in acceptable range (0.863), while the under-five mortality rate and the environmental variables seem to be under the hoped for. Overall, disparities between countries appear. More detailed statistics are in *Appendix 2*. Now, we present the estimation results based on the approaches mentioned above in order to answer the three research questions.

Results in Table 3 present the estimation of the effects of e-governance development on good governance. We use control of corruption (Eq.a.1), government effectiveness (Eq.a.2), and regulatory quality (Eq.a.3), as endogenous variables. According to the selection process of modeling, based on F-test and LM test, Pooled OLS method is more suitable for our mode than the EF or RE models.

Table 3. Effects of e-governance development on good governance

	Control of corruption (Eq.a.1)	Government effectiveness (Eq.a.2)	Regulatory quality (Eq.a.3)
	Pooled OLS	Pooled OLS	Pooled OLS
OSI	1.508* (0.376)	1.145* (0.325)	1.728* (0.325)
TII	1.304* (0.367)	1.396* (0.317)	0.438 (0.317)
HCI	-0.128 (0.386)	0.145 (0.333)	-0.059 (0.333)
EPI	-1.050* (0.353)	-0.726** (0.305)	-0.536*** (0.305)
VA	0.104 (0.202)	0.417** (0.174)	0.400** (0.174)
INTER	-0.047 (0.343)	-0.521*** (0.296)	-0.318 (0.296)
POP (log)	-0.167* (0.029)	-0.116* (0.025)	-0.238* (0.025)
HCIND(1)	-0.264** (0.116)	-0.308* (0.100)	-0.335* (0.100)
constant	2.114* (0.619)	1.278** (0.535)	3.382* (.534)
N	240	240	240
R ²	0.495	0.544	0.640
Prob(F)	0.000	0.000	0.000

*1%, ** 5%, ***10%. Values between parentheses are the standard errors.

The results demonstrate the following. Online service development and ICTs development contribute positively and significantly to control of corruption. When considering government effectiveness, OSI and TII have also a positive impact. For the regulatory quality equation,

OSI has a positive significant contribution while TII and HCI exert non-significant impacts. The human component has a positive impact on government effectiveness, but this impact is insignificant. We can say that e-governance development works well for the control of corruption and government effectiveness, and in a lesser extent, for regulatory quality. The human capital index does not have the expected impact. This implies that the MENA region needs more developed skills to benefit from the ICT divides.

As for the impacts of good governance on sustainable development, the table below presents the estimated results:

Table 4. Effects of good governance on sustainable development

	Economic development	Social development				Environmental management	Disaster management
	<i>GDP per capita(log)</i> (Eq.b.1) FE	<i>Rules of law</i> (Eq. b.2) FE	<i>Political stability & Absence of violence/terrorisme</i> (Eq. b.3) FE	<i>Under-five mortality</i> (Eq. b.4) FE	<i>Health index</i> (Eq. b.5) FE	<i>Ecosystem vitality</i> (Eq. b.6) FE	<i>Vulnerability to natural disaster</i> (Eq. b.7) FE
Goveff	0.001 (0.061)	0.322* (0.058)	0.723* (0.140)	-2.807 (1.710)	0.011 (0.007)	0.092 (0.060)	-4.309 (4.077)
CoC	-0.004 (0.053)	0.152* (0.050)	0.055 (0.122)	.497 (1.496)	-0.012** (0.006)	-0.148* (0.053)	2.915 (3.762)
RQ	.045 (.053)	0.201* (0.050)	0.187 (0.122)	4.911* (1.488)	-0.018* (0.006)	-0.052 (0.053)	0.661 (3.586)
VA	0.039 (0.037)	0.104* (0.035)	0.031 (0.085)	-.817 (1.044)	0.004 (0.004)	0.144* (0.037)	0.186 (3.312)
Pop (log)	-0.015 (.041)	0.007 (0.038)	-0.596* (0.094)	-8.510* (1.147)	0.051* (0.004)	0.546* (0.040)	-13.742 (5.162)
constant	9.490* (0.667)	-0.081 (0.629)	9.305* (1.523)	1.147* (18.548)	-0.001 (0.076)	-8.343* (0.660)	271.552 (84.947)
N	240	240	240	240	240	240	120
Prob(F)	0.7315	0.000	0.000	0.000	0.000	0.000	0.107

*1%, ** 5%, ***10%. Values between parentheses are the standard errors.

Results show that government effectiveness affects positively and significantly rule of law, political stability and absence of violence. However, it is not found to have any significant effect on GDP per capita, under-five mortality or the health index. The control of corruption has a significant impact on the variables rules of law, health index, and ecosystem vitality. Regulatory quality has a significant and positive impact on the health variables (health index and under-five mortality rate) and on the rule of law.

Now, the impact of e-governance development on sustainable development is shown in the table below.

Table 5. Effects of e-governance development on sustainable development

	Economic development	Social development			Environmental management	Disaster management	
	<i>GDP per capita(log)</i> (Eq.c.1)	<i>Rules of law</i> (Eq.c.2)	<i>Political stability & Absence of violence/terrorisme</i> (Eq.c.3)	<i>Under-five mortality</i> (Eq.c.4)	<i>Health index</i> (Eq.c.5)	<i>Ecosystem vitality</i> (Eq.c.6)	<i>Vulnerability to natural disaster</i> (Eq.c.7)
	<i>RE</i>	<i>FE</i>	<i>RE</i>	<i>FE</i>	<i>RE</i>	<i>FE</i>	<i>Pooled OLS</i>
OSI	0.168 (0.101)	0.075 (0.133)	-0.152 (0.263)	2.292 (2.369)	-0.005 (0.009)	0.048 (0.072)	-13.904 (7.109)
TII	-0.028 (0.123)	-0.627* (0.166)	-0.633** (0.313)	-9.267* (2.961)	0.054* (0.011)	0.220** (0.090)	-19.280*** (5.184)
HCI	-0.223 (0.164)	0.178 (0.216)	-0.014 (0.425)	-7.58*** (3.854)	0.063* (0.015)	-0.407* (0.117)	-19.251* (5.479)
EPI	0.050 (0.097)	-0.056 (0.128)	-0.471*** (0.252)	-3.972*** (2.275)	0.016*** (0.009)	0.062 (0.069)	5.465* (6.182)
VA	0.125*** (0.064)	0.242* (0.084)	0.347** (0.167)	-7.118* (1.508)	0.025* (0.006)	0.446* (0.045)	-9.990 (5.113)
inter	-0.323* (0.099)	-0.324* (0.131)	-0.830* (0.259)	14.499* (2.342)	-0.049* (0.009)	-0.787* (0.071)	13.221*** (7.653)
POP(log)	-0.388* (0.052)	0.249* (0.080)	-0.205** (0.104)	3.834* (1.425)	-0.006*** (0.003)	0.132* (0.043)	-0.129*** (0.439)
HCIND(1)	0.051*** (0.030)	0.017 (0.039)	0.085 (0.078)	-1.754* (0.702)	0.009* (0.002)	-0.060* (0.021)	-1.771 (1.469)
Constant	15.551 (0.864)*	-4.079* (1.305)	3.128*** (1.753)	-34.546 (23.197)	0.875* (0.064)	-1.477** (0.705)	73.001* (8.797)
N	240	240	240	240	240	240	120
R ²	-	-	-	-	-	-	0.648
Prob(F)	0.000	0.000	0.000	0.000	0.000	0.000	0.000

*1%, ** 5%, ***10%. Values between parentheses are the standard errors.

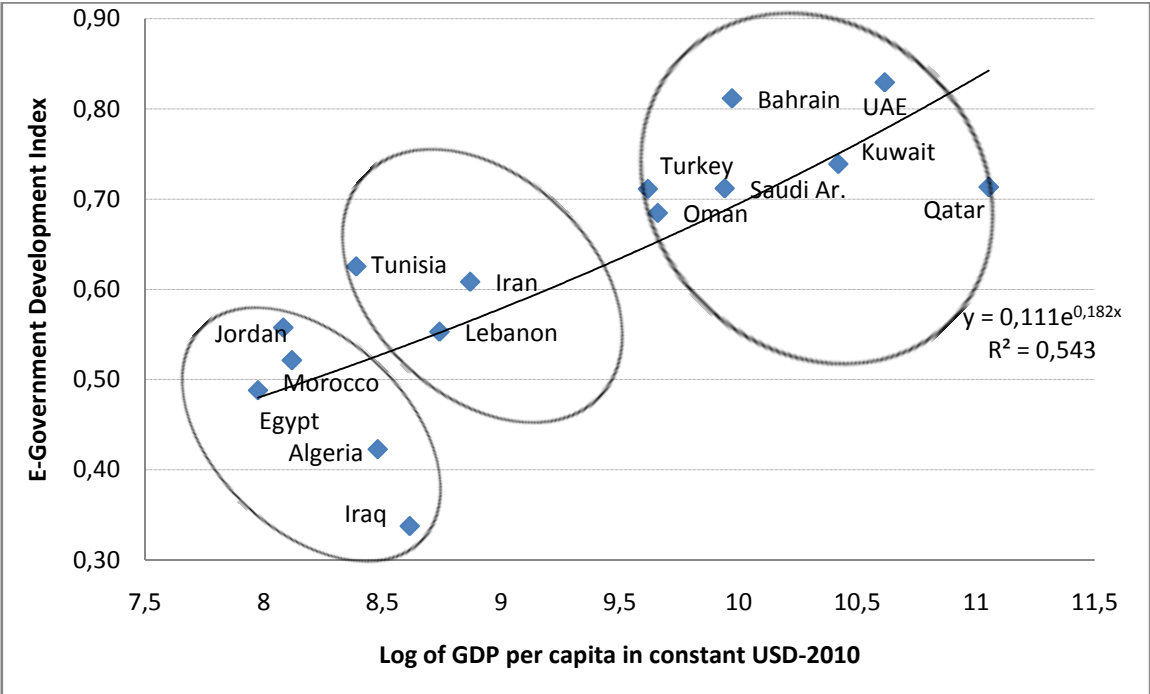
Results reveal that the three components (OSI, TII, HCI) of EDGI do not have a positive and significant impact on the various dimensions of sustainable development (especially the economic and social ones). This result can be explained by the fact that moving forward with the digital governance framework in MENA countries still faces many difficulties despite the great achievements accomplished to date. The new challenges remain heavily dependent on the development stage of each organization and each country. Indeed, digital transformation faces complex challenges from economic issues, social and political matters, to technology innovation and its diffusion patterns. E-governance reforms fail to be adequately embedded in public sector reform. As result, social and environmental divides seem to be limited, or the e-governance exerts an adverse effect on various aspect of sustainable development instead of to be a catalyst for progress. A conclusion that may emerge here is the inconclusive impact of e-governance on sustainable development in MENA Countries. Digital government efforts in the region are still perceived as technical support activities and not as a core strategic component for development corpus.

Thus, overcoming these challenges will require special awareness, commitment and a particular focus on ambitious and action-oriented strategies that contribute to bypass e-governance constraints, enhancing good governance, which in turn improves sustainable development and more inclusive societies.

Now, we move to comparative analysis to show the importance of e-governance and good governance development strategies for sustainable development in the MENA region.

The scatter plot below shows the relationship between the E-government readiness index (EDGI) and GDP per capita.

Fig.2 Scatter plot of EDGI and GDP per capita as of 2018



From Figure 2, a positive relationship between countries’ EDGI performance and economic development emerges. Also, this correlation has an exponential tendency. For instance, rich Gulf countries and Turkey tend to have higher EDGI scores in relation to their Gross Domestic Product per capita compared to other countries, in particular, Iraq, Algeria and Egypt, which tend to have the poorest results. The other countries (Tunisia, Iran, and Lebanon) are in an intermediate position. This tendency implies that countries with more financial resources can better implement policies to develop ICTs and go forward into digitalization. However, this is not always the case; some MENA countries have high GDP per capita but receive low scores on the overall EDGI. This result suggests the role of

something other than economic development alone, such as good governance performance that may also be critical in achieving e-governance goals.

Based on the results obtained from the relationships between EDGI, e-governance dimensions, and various aspects of sustainable development, we divide the sample countries into groups and for each group, we put its performance in good governance and in sustainable development. For each country, we count the number of good performances. We will check whether the country grouping still the same.

Table 6. EDGI and performance in good governance and sustainable development

Group	Country	EDGI	CoC	GovEff	RQ	IGDPC	RoL	PSAV	MOR	HI	EV	VUL	No of good performance
Group A	UAE	0.830	1.152	1.431	0.932	10.616	0.806	0.743	7.6	0.890	0.529	31.510	11
	Bahrain	0.812	-0.147	0.180	0.446	9.973	0.413	-0.840	7.1	0.879	0.484	37.650	9
	Qatar	0.713	0.725	0.631	0.515	11.054	0.735	0.678	6.8	0.925	0.635	35.480	11
	Saudi Ar.	0.712	0.360	0.323	-0.046	9.942	0.142	-0.518	7.1	0.846	0.473	35.090	8
	Oman	0.685	0.246	0.187	0.310	9.659	0.465	0.655	11.4	0.887	0.349	40.670	9
Group B	Kuwait	0.739	-0.289	-0.088	-0.036	10.420	0.211	0.110	7.9	0.852	0.568	34.840	7
	Turkey	0.711	-0.335	0.006	-0.047	9.618	-0.319	-1.329	10.6	0.884	0.406	40.330	6
	Tunisia	0.625	-0.053	-0.105	-0.411	8.390	0.039	-0.902	17	0.869	0.498	43.080	5
	Jordan	0.558	0.150	0.113	0.083	8.082	0.234	-0.379	16.2	0.837	0.459	44.120	4
	Morocco	0.521	-0.216	-0.209	-0.243	8.119	-0.138	-0.332	22.4	0.869	0.608	47.670	3
Group C	Iran	0.608	-0.959	-0.430	-1.296	8.869	-0.694	-1.307	14.4	0.869	0.476	43.550	1
	Lebanon	0.553	-1.109	-0.640	-0.342	8.740	-0.764	-1.645	7.4	0.906	0.463	43.540	2
	Egypt	0.488	-0.587	-0.585	-0.867	7.975	-0.412	-1.165	21.2	0.797	0.563	48.320	1
	Algeria	0.423	-0.636	-0.444	-1.264	8.480	-0.775	-0.794	23.5	0.872	0.413	45.690	1
	Iraq	0.338	-1.399	-1.321	-1.219	8.614	-1.759	-2.556	26.7	0.776	0.310	56.550	0
Average		0.621	-0.207	-0.063	-0.232	9.237	-0.121	-0.639	13.820	0.864	0.482	41.873	5.3

The results reveal that Qatar, UAE, Oman, Bahrain and Saudi Arabia have a score ranged between 11 and 8 followed by Kuwait, Turkey, Tunisia, Jordan, and Morocco. Higher performers show higher scores across many variables.

Now, we plot a scatter of EDGI and the number of good performances in good governance and sustainable development to show the sign and tendency of the relationship and to check whether the country grouping still the same.

Fig.3 Scatter plot of EDGI and the number of good performances in good governance and sustainable development as of 2018

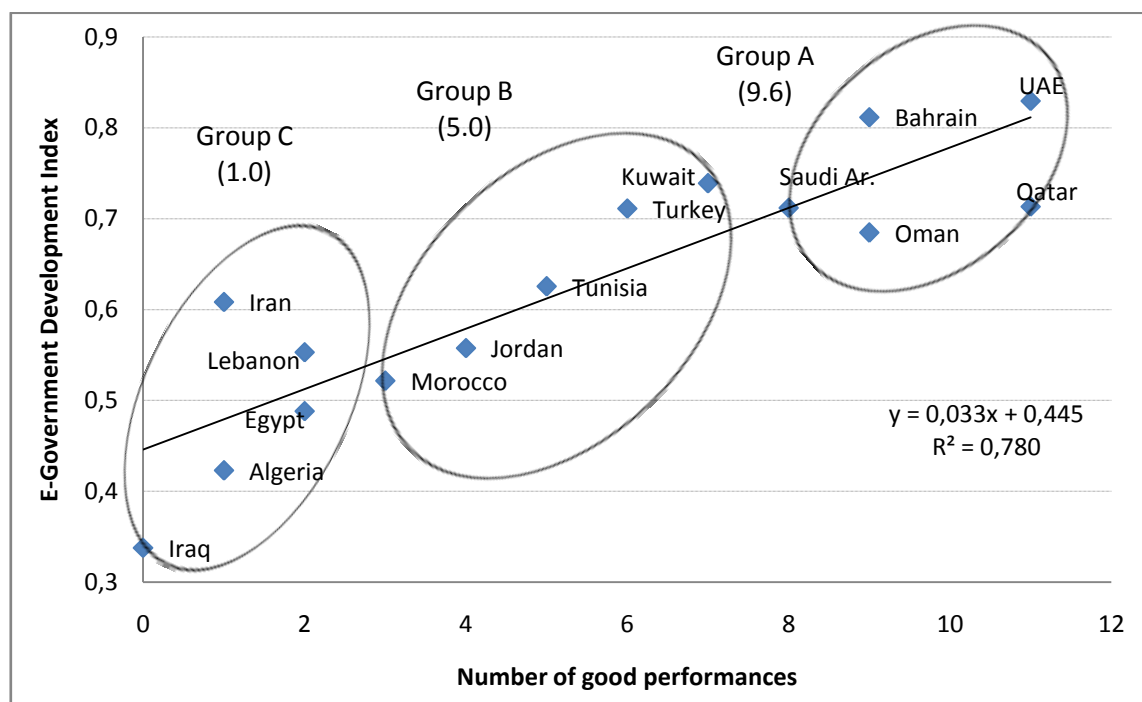


Figure 3 suggests that as the number of good performance increases, the E-Government Development index. The scatter plot shows a positive correlation between EDGI and good performances in good governance and sustainable development. The number of good performance is more dispersed in their relation with EDGI than GDP per capita in relation with EGDI and the country grouping does not still the same. Iraq, Algeria, Egypt, Lebanon, and Iran have the lowest number of good performance and the lowest EDGI score. Gulf countries tend to have higher EDGI scores in relation to their number of good performances. The other countries are in an intermediate position. Having good performances in terms of GDP per capita and social indicators do not guarantee alone higher E-governance index (the case of Kuwait). The role of E-governance is also crucial. In this context, corruption reduces the positive impact contribution of good governance and thus hinders public welfare and social development. Therefore, the conclusion is that e-governance can contribute heavily to sustainable development but first it should have the expected positive impacts on good governance.

5. Conclusion and policy recommendations

Electronic governance and good governance have been a topic of discussion in the international arena. Indeed, these two frameworks are pivotal to the sustainable development

process. ICTs and digital technologies are one of the most transformational factors of our time, including their impact on effective good governance and sustainable development.

In order, to seek the economic, social and environmental needs sustainability for MENA countries, it is crucial to establish good governance by forming an institutional environment capable to enable government with more effective and efficient tools for more successful development plans. The gather benefits, policies on the use of digital technologies need to be adequately embedded in public sector reform. Bring digital technology and governance practices together at the forefront of sustainable development strategies and provide new and innovative technological options leading to improve governance strategies may contribute heavily to achieve sustainable development in all dimensions. A particular emphasis on building a digitally inclusive society is needed. Sound strategic and policy framework and progressively revise the contribution of ICTs may support the shift towards good governance and thus more sustained development.

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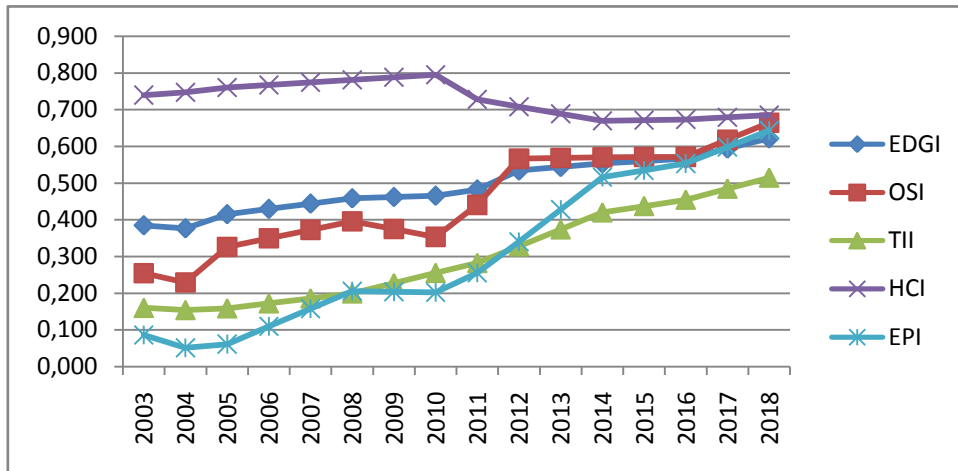
Appendix 1. Variables of the study

Area	Factors	Variables/ conceptual definition	Sources
ICT Infrastructure	Telecommunication Infrastructure Index (TII)	Internet users (%)	UN E-Gov't Survey 2003-2018 (based on ITU's IDI)
		Main fixed phone lines (%)	
		Mobile subscribers (%)	
		Fixed Internet subscriptions (%)	
		Fixed broadband subscriptions (%)	
Ability to use E-Government	Human Capital Index (HCI)	Wireless broadband subscriptions (%)	UN E-Gov't Survey 2003-2018 (based on UNDP's HDR)
		Adult Literacy (%)	
		Primary, secondary, tertiary Gross Enrollment (%)	
		Expected years of education	
E-Public Service	Online Service Index (OSI)	National website's services level (e.g. gov't portal, ministries' websites)	UN E-Gov't Survey 2003-2018
E-Democracy	E-Participation Index (EPI)	E-Information, E-Consultation, E-Decision making	
Government Transparency	Control of Corruption (CoC)	The extent to which public power is exercised for private gain, including both petty and grand forms of corruption	World Bank's Worldwide Governance Indicators (WGI) 2003-2018 combined from several sources including EIU, IMD, ADB, Freedom House, and so on
		Capture of the state by elites & private interests	
Government capabilities	Government Effectiveness (Goveff)	Quality of public services	
		Quality of civil service and the degree of its independence from political pressures	
		Quality of policy formulation and implementation	
Regulatory Quality (RQ)	Regulatory Quality (RQ)	Credibility of the gov't's commitment to policies	
		The ability of the gov't to formulate and implement sound policies and regulations that promote private sector development	
Economic Development	GDP per capita (GDPC)	GDP (constant 2010, USD) / population	World Bank 2003-2018
Social development	Rule of Law (RoL)	The extent to which agents have confidence in and abide by the rules of society	World Bank's Worldwide Governance Indicators (WGI) 2002-2018
		Quality of contract enforcement, property rights, the police, and the courts	
		Likelihood of crime and violence	
	Political Stability & Absence of Violence/Terrorism (PS&AVT)	Unlikelihood that the gov't will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence & terrorism	
	Under-five Mortality Rate (UFM)	Under-five mortality (per 1,000 live births)	
Health Index (HI)	Health Index (HI)	Life expectancy at birth	UNDP's human development index (HDI)

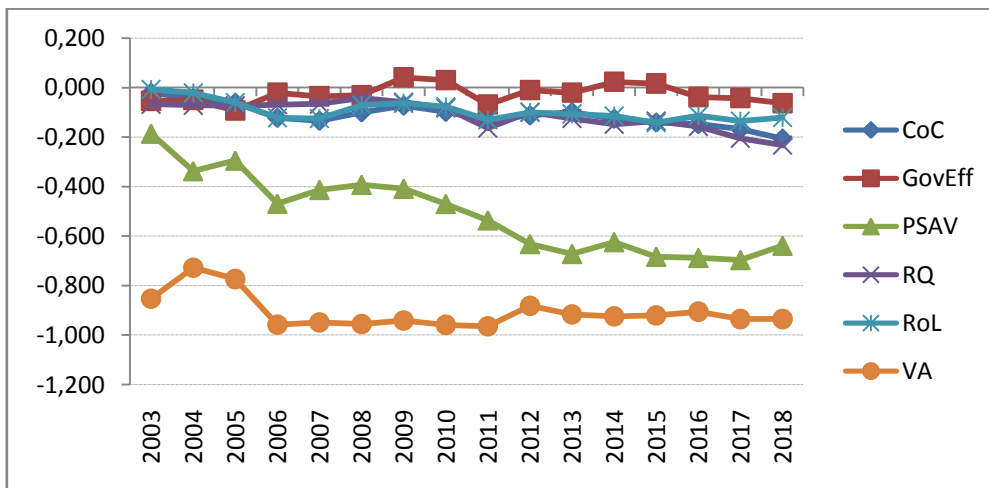
Ecosystem vitality (EV)	Water Resources	Wastewater Treatment Level	Environmental Performance Index (EPI) of Yale Univ. (YCELP) & Columbia Univ. (CIESIN) 2002-2016 combined from several sources including WHO, UNICEF, World Bank, UNEP, IEA, FAO, and so on
	Agriculture	Agricultural Subsidies Pesticide Regulation	
	Forests	Change in forest cover	
	Fisheries	Coastal Shelf Fishing Pressure Fish Stocks	
	Biodiversity & Habitat	Terrestrial protected areas (national biome weights)	
		Terrestrial protected areas (global biome weights)	
		Marine Protected Areas Critical Habitat Protection (%)	
	Climate & Energy	Trend in Carbon Intensity Change of Trend in Carbon Intensity	
		Trend in CO2 Emissions per KWH	
Vulnerability to Natural Disaster (VUL)	Susceptibility	Population without access to drinking water(a) & sanitation (%)	World Risk Report (Alliance Development Works and UNU-EHS) 2011-2018
		Nutrition	
		Poverty and dependencies	
		Economic capacity & income distribution	
	Coping capacities	Government & authorities	
		Medical services	
		Material coverage	
	Adaptive capacities	Education & Research	
		Gender equity	
		Environmental status & ecosystem protection	
	Investment		

Appendix 2. Evolution of indicators (average) between 2003 and 2018

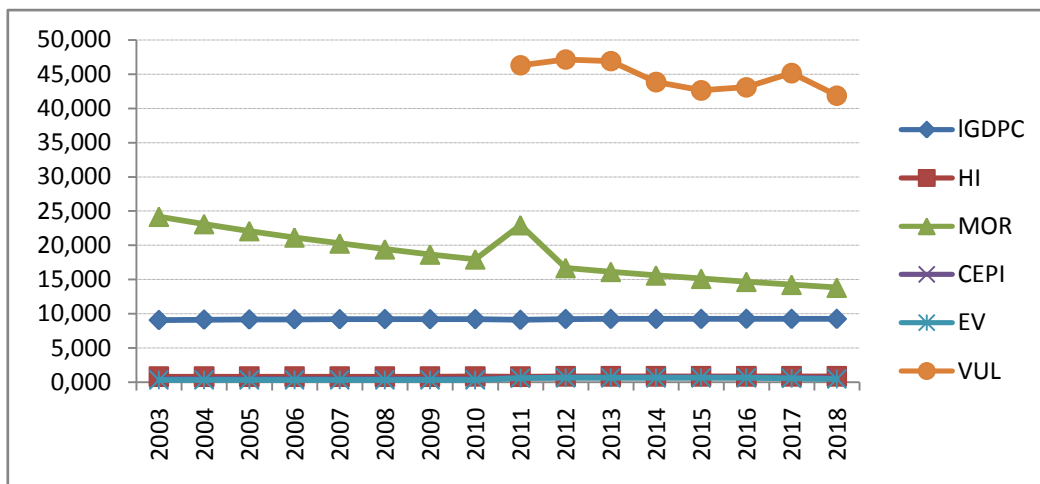
E-government Development



Good Governance



Sustainable Development



Appendix 3. Model selection based on Hausman-test, F-test and LM-test

	F-test		LM-test		Hausman test		Selected model
	F-statistic	Prob>F	Ch(2)	Prob> chi2	Chi (2)	Prob> chi2	
Model a.1	0.91	0.5539 ^a	793.70	0.000 ^f	-	-	Pooled OLS
Model a.2	1.65	0.0681 ^a	620.89	0.000 ^f	-	-	Pooled OLS
Model a.2	1.55	0.0947 ^a	547.63	0.000 ^f	-	-	Pooled OLS
Model b.1	18.19	0.000 ^f	1474.86	0.000 ^f	16.50	0.0056 ^f	FF Model
Model b.2	2.00	0.0167 ^f	781.46	0.000 ^f	13.18	0.0218 ^f	FF Model
Model b.3	2.69	0.0009 ^f	467.66	0.000 ^f	36.47	0.000 ^f	FF Model
Model b.4	71.14	0.000 ^f	489.76	0.000 ^f	111.48	0.000 ^f	FF Model
Model b.5	48.56	0.000 ^f	409.62	0.000 ^f	254.90	0.000 ^f	FF Model
Model b.6	48.56	0.000 ^f	409.62	0.000 ^f	172.38	0.000 ^f	FF Model
Model b.7	3.11	0.0054 ^f	46.07	0.000 ^f	14.52	0.0126 ^f	FF Model
Model c.1	13.66	0.000 ^f	792.34	0.000 ^f	1.36	0.9948 ^a	RE Model
Model c.2	3.57	0.000 ^f	763.10	0.000 ^f	30.69	0.0002 ^f	FF Model
Model c.3	4.93	0.000 ^f	832.41	0.000 ^f	7.73	0.4601 ^a	RE Model
Model c.4	42.72	0.000 ^f	486.79	0.000 ^f	19.07	0.0145 ^f	FF Model
Model c.5	29.71	0.000 ^f	1067.96	0.000 ^f	1.99	0.9813 ^a	RE Model
Model c.6	21.91	0.000 ^f	57.82	0.000 ^f	22.35	0.0043 ^f	FF Model
Model c.7	1.98	0.0773 ^a	19.47	0.000 ^f	-	-	Pooled OLS

Note: For the F-test, the null hypothesis is that the coefficients for all years are jointly equal to zero. For LM test, the null hypothesis in the LM test is that variance across entities is zero, i.e no significant difference across units (i.e. no panel effect). For Hausman test, the null hypothesis denotes non-correlation between an individual effect and regressor. We Conduct the Hausman test when both hypotheses of the F-test and LM test are all rejected.

Note: (a): the null hypothesis is accepted; (R): The null hypothesis is rejected.

