Investigating Factors Influencing Open Government from a Country's Perspective

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Abstract. Open government (OG) has been seen as the act of government facilitating transparency and accommodating citizen and stakeholder engagement for public decision-making. Despite the widespread implementation of open government initiatives, what factors influence open government from a country's perspective remained unclear. This article investigated socio-technical aspects of open government by looking at five factors: e-government development, freedom of press, innovation capabilities, digital skills, and legal adaptability. This study used secondary data from 137 countries to measure the factors influencing OG globally, employing a multiple regression model. Only digital skills are considered less influential in open government initiatives among all the five factors.

Keywords: Open government · Factors · Country

1 Introduction

Practitioners and academics are increasingly concerned about government transparency and disclosure of data and information due to the development of information technology and the Internet [94]. Globally, countries are facing a number of complex issues, including inefficient and ineffective governance, legal barriers, slow economic recovery, corruption, aging technological infrastructure, and a reduction in freedom of the press [58, 77]. Those issues are considered the causes of the declining trend in trust in government, which some scholars classify as national economic [13, 21, 32, 53], socio-cultural [47, 70], and politics [66] causing factors. A great deal of research efforts has been done to find strategies for tackling challenges and reversing the loss of faith in government. One of the remedies is to have an open and transparent government [67, 71].

Open government is defined "as the extent to which a government shares information, empowers people with tools to hold the government accountable, and fosters citizen participation in public policy deliberations" [91]. Based on that definition, OG encompasses various mechanisms to ensure that the government fulfills the functions of transparency, accountability, and citizen participation. Since the first movement in

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the 1990s, more and more countries and jurisdictions have participated in open government initiatives and transformed their government sectors to be more transparent and accountable for citizens, increase citizen-government engagement, and reap the benefits for all stakeholders [1, 31, 41, 89]. Currently, the global and largest OG partnership called Open Government Partnership notes that 77 countries and 106 local governments have joined the partnership, ranging from low-income to high-income countries [64].

1.1 Problem Statement and Research Question

Many countries worldwide have devoted their resources to transforming their government into open governments [27, 31]. Several studies have investigated, initiated, and advocated for open government initiatives to understand government actions better. For instance, some scholars concentrate on one of the OGD initiatives, i.e., open government data (OGD). These scholars investigate the benefits of OGD [60–62], potential barriers to its adoption [35, 48, 55, 68], and the public sector and open data [29, 38]. Previous studies have also discussed factors influencing government institutions' adoption of open government-related data at the institution and a specific country level [23, 52, 80, 81]. These existing studies highly focus on examining open government at the institution level or in a particular country.

As more and more countries and jurisdictions have committed to an open government, there is a need to understand this phenomenon at the global level. Few attempts have been made to investigate factors influencing the adoption and implementation of OG at the country level. These existing studies highly focus on examining open government at the institution level or in a specific country. This study examines the socio-technical factors that influence the implementation of open government from the perspective of countries globally. We aim to answer the following research question: "What factors influence the implementation of OG globally?".

A conceptual model is proposed to explain how these factors influence OG implementation at the country level. Using secondary data from 137 countries taken from several international, recognized, and reputable sources. This study makes a valuable contribution to filling the gap in current literature and practice regarding OG factors as seen from a global perspective by providing a holistic understanding of the factors that contribute to the successful implementation of OG initiatives by taking an in-depth look at these factors. It also helps researchers establish evidence-based theoretical models for implementing OG based on the findings. As a result of the study, government managers, policymakers, and practitioners can formulate more effective strategies for managing OG initiatives and prioritizing the factors contributing to building an open, transparent, and collaborative government.

2 Literature and Hypotheses

2.1 Open Government: Definition, Benefits, and Challenges

Open government is not universally defined despite the adoption and implementation of OG in various countries [89]. According to the Organization for Economic Cooperation and Development, openness and responsiveness are attributes of an effective

government [25]. Open government also refers to transparent, participatory, and collaborative government activities concerning citizens or businesses [26]. Furthermore, OG has been defined from the citizens' perspective, who have access to government information and decision-making, which involves monitoring and influencing government policy [51]. OG also integrates external knowledge into political and administrative processes through information and communication technologies [78].

Another study demonstrated that ICT could be a tool for promoting government transparency through citizen participation and collaboration [19]. ICT enables open government initiatives such as e-government and open data to make government more accessible, transparent, and service-oriented [30].

The definition of open government accentuates its three core values, transparency, collaboration, and public participation. Recent studies have explored the values or benefits of OG. Scholars such as [35, 54] categorized the benefits of OG based on political, social, and economic benefits. Other literature also coined OG to reduce corruption, generate economic growth and innovation, improve the public sector's responsiveness to citizens and businesses [25, 50, 83], and increase engagement between government, community, and citizens [41, 74]. OG is also believed to increase government accountability as a decisionmaker, as opening government data to the public will force the government to be more aware of its decision-making process [44].

Meanwhile, Schnell and Jo [79] state that political factors such as transparency and government openness are fundamental democratic values. Both are the demands or expectations of citizens of their government. In addition, both values also function as a check on executive power.

OG also increase the knowledge of citizens regarding what their government is doing. As a result, it can reduce information asymmetries between government and citizens and monitoring costs [49]. Furthermore, open government has been seen as an evolving and important topic for government practice and research, within which five dimensions are intertwined: information availability, transparency, participation, collaboration, and information technology [27].

Implementing OG is not without a challenge. Ubaldi [83] discussed six key dimensions for OGD initiatives among OECD members. These dimensions, which were referred to as "challenges," include a) policy challenges, b) technical challenges, c) economic and financial challenges, d) organizational challenges, e) cultural challenges, and f) legal challenges. In addition to presenting the challenges, the paper also discussed several examples of how the OECD member countries had encountered the challenges. For instance, policy challenges were discussed with the example from the UK Cabinet Office that published the Open Data White paper in June 2012, followed by the first Open Data Strategy in each government department. The "Regulations.gov" case study was mentioned to give an idea of the technical challenges in the US government. Due to its exclusivity rule with a limited search engine capability, the "OpenRegulations.org" was created to compete with the "Regulations.gov," where simple-to-navigate listings and a more sensible set of RSS feeds were offered, one for each department agency.

2.2 Implementation of OG Across Countries

Many countries have taken open government initiatives. The Open Government Partnership (OGP)—the most prominent international initiative promoting open government—stated that a growing number of countries and jurisdictions have participated in that partnership since its first initiation in 2011. Currently, their members comprise 77 countries and 106 local governments [64] around the world.

The government takes many initiatives to implement OG. One can be seen by looking at its open government policies, programs, and structural organizations. A previous study analyzed policy documents that include relevant policies and open government-related action plans in seven OGP members: Azerbaijan, Brazil, Canada, Kenya, Netherlands, the UK, and the US [14]. OECD mentioned some relevant policies for open government, such as the law on privacy and data protection, e-government policies, public interest disclosure policies, the law on access to information, et cetera [25]. Additionally, the presence of OG initiatives can also be seen by investigating common objectives and difficulties across OGP countries when implementing their open government action plans. For example, a previous study investigated the common objectives among three OGP countries, Brazil, France, and the US, and found out that the main objective of open government plans was to restore confidence in governments [7]. The study also revealed common difficulties, such as the ability to resist political changes and low public participation.

Another essential initiative is the publication of government data to the public. Not only at the national level, many government institutions at state and local levels also have data portals as the repository of government data accessible and available to the public [22]. Global Open Data Index presents the benchmark of 94 countries regarding the publication of government data on their portals, ranging from the government budget and procurement to land ownership data [37]. An independent organization also releases a WJP Rule of Law Index of 139 countries based on the indices of eight measurements, one of which is the open government index [91]. OG index measures the degree of government openness. Based on that index, Norway is the highest rank in open government index, followed by Denmark, Finland, Sweden, and the Netherlands in the second, third, fourth, and fifth ranks. Republic or Iran, Cambodia, and Egypt are countries with the lowest open government index.

Furthermore, a previous study [4] examined government websites in the Middle East to see if open government principles are being implemented. Among the 13 Middle Eastern countries under study, only three have made government-owned data public, Bahrain, United Arab Emirates (UAE), and Saudi Arabia promoting government transparency through open data and facilitating public engagement. Meanwhile, in the United States, open government data is primarily addressed through laws in Paperwork Reduction Act 1980, which primarily sought to reduce the federal paperwork burden for individuals, small businesses, and local and state governments. Minimizing the cost, maximizing the usefulness of the information collected, coordinating, integrating, and ensuring automatic data collection, processing, use, and dissemination is achieved.

Although OG initiatives have been implemented in many countries, there have been variations in evaluating their effectiveness. Evaluating ongoing OG initiatives can consider some technical, organizational, and regulation criteria. However, it is important to

note that there is still little discussion on what factors are important to consider when designing and implementing global OG initiatives. A study pointed out that open government data research, as part of open government, typically undergoes four main phases, including a) OGD launch, b) evaluation and learning, c) OGD adoption and use, and d) implementation and comparison among countries [24]. Thus, studying influential factors affecting OG implementation can help the government manage OG initiatives, from planning to evaluation.

2.3 E-Government Development and Open Government

A technological revolution has forced the government to develop citizen services and digital government operations [42]. Many have noted that ICT is the key to promoting open government [19]. ICT enables the government to implement various initiatives to create a more open, accessible, transparent, and service-oriented government for the public [30]. As many scholars have paid attention to strategies in increasing trust in government, open government is believed to be the remedy for losing faith in government [59]. A government reform to be more open and transparent through the help of ICT and especially e-government is the solution. Through various e-government initiatives, citizens can access and receive government services effectively and efficiently [16], control and monitor government programs and activities, and other types of participation, including e-voting [2, 15]. E-government is associated with open government as it creates a massive amount of government data and thus triggers the government to publish its data to the public. The availability of government data in a massive number also stipulates that citizens push the government to be more open regarding their data and activities. Open government data (OGD) implementation is a global focus of government institutions.

However, a previous study [6] investigated the challenges of open government data. Most are related to technical challenges, such as data formats, ambiguity, quality, et cetera. In the literature on information systems, successful information systems, including e-government systems, are seen from the quality of their systems, services, and data/information [17, 18]. E-government is the key to open government [1, 43]. Therefore, we argue that e-government plays a vital role in achieving full openness in government. The better the e-government development in a country, the better the implementation of its open government is.

Hypothesis 1:
E-government development positively influences the implementation of OG.

2.4 Freedom of Press and Open Government

One of the core components of open government is transparency, defined as "the extent to which government makes available the data and documents the public needs in order to assess government action and exercise voice in decision-making" (p. 87) [31]. Transparency also enables government-citizen engagement. Citizens are not only allowed to access government data but also the freedom to monitor what the government is doing and report government performance to the public. Open government is often associated with freedom of press and freedom of information.

The Reporters Without Borders (RSF) defines press freedom as "the right for journalists to select, produce, and disseminate news in the public interest without political, economic, legal, or social interference and without threats to their physical and mental well-being." Press freedom includes freedom of expression, opinion, and information [76] which can be linked to the Freedom of Information Act. An individual's right to freedom of expression occurs when there are no restrictions in the media.

Despite some arguments against FOI, a previous study [9] mentioned five strong arguments favoring FOI. First, information should be used for public interests because the existence of government is to protect public interests. Second, to be accountable, the government needs to reveal what they are doing. So, information is the key to accountability. Third, a good government requires reliable and available information. Forth, it is the right to citizenship. In the US, for example, Article 19 of the Universal Declaration of Human Rights states that everyone has a right to access information, including "freedom of expression, opinion, and search, receive, and impart information and ideas regardless of frontiers." According to Article 19 of the 1966 International Covenant on Civil and Political Rights, freedom of expression includes the right to seek, receive, and impart information, ideas, and opinions of any kind, whether it is written, spoken, or otherwise [65]. Fifth, the exclusivity to possess information harms democracy and can lead to corruption and other abuse of power.

Both movements—the freedom of press and freedom of information—have forced governments to release data and make it easily accessible [19]. The movements also emphasize accountability and transparency, improve citizen preferences [40, 86], and amend previous data policies [8]. It involves media independence and citizens having access to the media. Having free media can help facilitate informed public debate, provide a forum for citizen perspectives, and limit government power and corruption. Press freedom helps to reduce corruption and bring about accountability [11]. Open government and press freedom are interconnected [63]. Thus, open government leads to greater press freedom.

Hypothesis 2:
Freedom of press positively influences the implementation of OG.

2.5 Country's Innovation and Open Government

Innovation is the heart of economic growth and social development. Porter (2001) mentioned that to be an innovative country, private sectors, including firms, are the engines. However, these private sectors depend on national policies to be innovative. Porter concluded that the strength of innovation in a country requires a good collaboration between private and public sectors [72]. Moreover, Porter highlighted that innovation resulting in competitive advantage and economic development could only be achieved whenever a favorable and collaborative environment exists. Innovation is not only believed to tackle economic challenges but also other wicked problems such as aging societies, climate changes, political instability, and other social and human issues [69].

The degree of innovativeness of a country is different from one another. Porter and Scott (2001) explained the aspects of innovative national capacity that shape a nation's innovation capability. One of the elements is the nation's common innovation

infrastructure which encompasses "the set of cross-cutting investments and policies supporting innovation through an entire economy" (p. 5) [73]. Moreover, they mentioned that a fundamental of a strong innovation infrastructure is the government's support in building excellent research so that scientists and engineers can contribute to innovation. A country with good innovation capacity is committed to economic openness, including openness in trade and investment.

An open government environment emphasizes collaboration and participation, two elements that a country requires to be an innovative country. A country that emphasizes openness tends to be more flexible in organizing the collaboration and participation among the public, private sectors, and citizens. For example, some countries with high innovativeness, such as the United States, provide incentives for private investment in broadband infrastructure and liberalization in telecommunication networks to encourage more industry competition [12, 20]. However, the same policies could not be applied in other countries because various issues, such as the government's ideology, can influence a country's degree of innovativeness [87].

In addition, the open government also aims to create a more accountable government. A previous study [45] argued that innovation and economic development are related to good governance or how well the quality of government is defined by three basic elements, i.e., accountability, transparency, and justice. An innovative environment requires accountability marked by the absence of the abuse of power, "democracy and political pluralism," and participatory development (p. 9) [45]. They also mentioned the importance of freedom and the need for government to be open so that citizens can trust more in government, which eventually will reinforce positive development.

Therefore, we hypothesize that the degree of innovation in a country influences the implementation of open government. The more innovative a country is, the more it needs a government that supports an open, transparent, collaborative, and participative environment.

Hypothesis 3:
Innovation capabilities positively influence the implementation of OG.

2.6 Digital Skills

Open government facilitates government administration and provides better services to citizens and businesses. It facilitates the participation of citizens in democratic institutions and political processes. With the spread and adoption of technology, digital and technology-related skills are becoming increasingly crucial.

Digital skills are important in realizing open government, as one of the goals of open government is to be more engaged with citizens. Without these skills, citizens may not be able to access e-government services and government data [28]. There are two crucial aspects of digital skills, online information, and services [85]. Furthermore, Van Deursen and Van Dijk (2009) classified digital skills into operational skills (digital media skills), formal skills (internet skills), information skills (search, select and evaluate e-information), and strategic skills (e-skills attached to a goal). Citizens need to have these skills in order to access government data and services.

Moreover, by nurturing their digital skills, citizens are forced to interact with the government using different applications [5, 10, 33], such as e-government. A previous study noted an association between e-government and digital skills [75]. Following the same logic, we assume that digital skills positively influence the realization of open government initiatives.Hypothesis 4:

Hypothesis 4:
Digital skill positively influences the implementation of OG.

2.7 Adaptive Regulation and Open Government

An open government is functional when it is transparent, accountable, participatory, and collaborative. However, laws are also a vital component of open government. Citizens have the right to access information on public issues, public utilities, and decision-making processes through laws on the right to access information.

Learning from the United States, some policies, regulations, and laws are enacted, revised, and reenacted to facilitate government transparency. According to Article 19 of the Universal Declaration of Human Rights, everyone has a right to access information. According to Article 19 of the 1966 International Covenant on Civil and Political Rights, freedom of expression includes the right to seek, receive, and impart information, ideas, and opinions of any kind, whether it is written, spoken, or otherwise. Moreover, the Paperwork Reduction Act (PRA) was revised in 1995 to emphasize enhancing the quality and use of federal information, disseminating public information, and ensuring its integrity. Alongside the PRA, McDermott (2010) highlighted 1985 Circular A-130, which essentially states that government information is government information, and that the public has no right to access it. In addition, his study also pointed out that the E-Government Act of 2001 is the only legislation focusing on the government's management of its information content for access and accountability (p. 406) [50]. In 2002, the E-Government Act was rewritten and codified by the Federal Chief Information Officer (CIO) Council, whose activities have largely been unaccountable. The ability of a country to adapt to the required regulation is thus necessary for creating an open government. We hypothesize that the legal adaptability of a country influences the implementation of open government.

Hypothesis 5:
Legal adaptability positively influences the implementation of OG.

3 Conceptual Model

This paper investigates factors that influence a country's realization of open government. The five hypotheses emphasize the role of e-government development, freedom of press, innovation capabilities, digital skills, and legal adaptability of a nation to influence open government. In other words, open government implementation in a nation is a function of e-government development, freedom of press, innovation capabilities, digital skills, and legal adaptability. We depict the proposed relationship using Fig. 1.

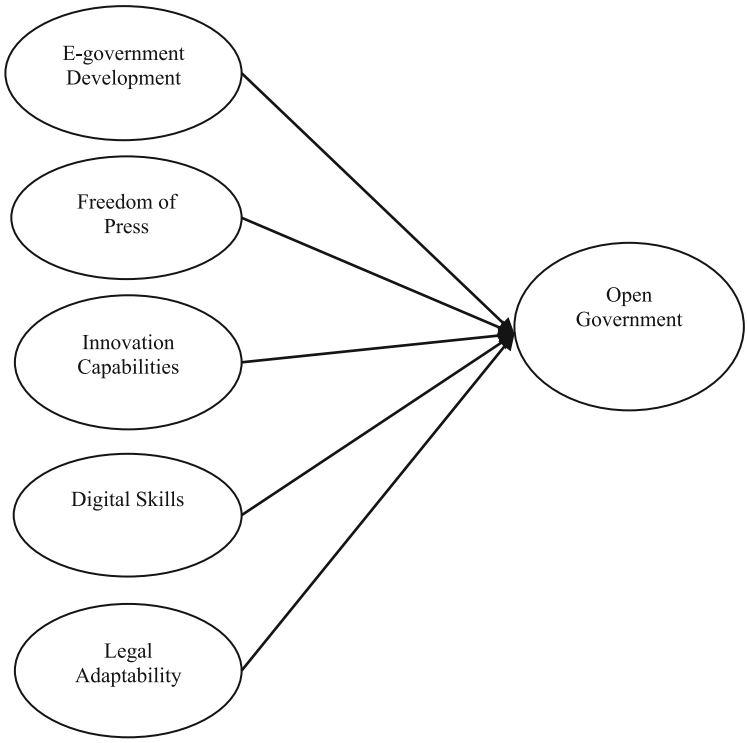


Fig. 1. The conceptual model

4 Methods

Based on the research model (Table 1), our study consists of six variables: open government, e-government development, freedom of press, digital skills, innovation capabilities, and legal adaptability to digital innovations. This study investigates the determinants of OG implementation using the data of 137 countries. The variables used in this study were taken from different data sources, i.e., World Bank Global Competitiveness 4.0 Index in 2019 [93], United Nations E-Government Survey for 2020 data [84], and World Justice Project Index in 2020 [90].

To test the hypotheses in our study, we used variables as depicted in Table 1. As we investigate the factors influencing open government, the dependent variable in the model is Open Government. We use the Open Government Index obtained from the World Justice Project Rule of Law Index [92] to measure this dependent variable.

The first factor we predict to influence is e-government development. We use the e-Government index, obtained from United Nations E-Government Survey to measure this factor, followed by an independent variable freedom of press. This variable is measured using the Press Freedom Index from World Bank Global Competitiveness 4.0 Index [93]. We also use innovation capabilities, which relies on the innovation capabilities indicator from World Bank Global Competitiveness 4.0 Index as the measurement. Digital skills

and legal adaptability, we use World Bank Global Competitiveness 4.0 Index data to operationalize these variables.

Table 1. The variables and their measurements

Type	Variable name	Measurement	Data type
Dependent variable	Open government	Open government index (0–1 scale)	Ordinal
Independent variable	E-government	E-government index (0–1 scale)	Ordinal
	Freedom of press	Press Freedom index (0–100% score)	Ordinal
	Innovation capabilities	Innovation capabilities (0–100% score)	Ordinal
	Digital skills	Digital skills (0–100% score)	Ordinal
	Legal adaptability	Legal framework's adaptability to digital business models (0–100% score)	Ordinal

The study considered only countries whose data are in all databases. At first, there were 139 countries; however, we omitted 2 countries (Sierra Leone and Liberia) due to significant missing data. However, we still experienced some missing data. We use the simplest mechanism to address this by imputing the missing data by their means [34]. We imputed 15% (22 records) of Open Government Index data and 2% (3 records) of the legal adaptability variable. We realized that imputation by means could lead to bias. Thus, we discussed this issue in our future recommendation.

We analyze our data using multiple regression. To conduct the regression analysis, we ensure the three assumptions are met, i.e., linearity, normality, and homoscedasticity. We use the scatter plots and correlation matrix to ensure that each independent variable as a predictor has a linear relationship with the outcome or the dependent variable. In addition, the scatterplots and correlation matrix are also used to check the presence of multicollinearity issues among the independent variables. Descriptive analysis and histogram are used to describe the normality. Next, a residual plot is used to check the homoscedasticity.

5 Results and Findings

We check the three assumptions before conducting the analysis using multiple regression. We use scatterplots, correlation tables, and VIF values to check the first assumption, i.e., the linearity (Appendix). The scatterplots show a positive linear relationship between each pair of independent variables and the dependent variable. The correlation matrix also confirms the scatterplots, indicating strong linear relationships, as the values range between .568 and .679. We also check the multicollinearity issues using correlation tables

and the Variance Inflation Factors (VIF) values. The correlation table shows no multicollinearity issue since the highest correlation value among two independent variables is below the cutoff value of .8. The VIF values of all predictors are far below the cutoff value of 10; therefore, there is no issue with multicollinearity. Therefore, the linearity assumption is met. The dependent variable is normally distributed over the independent variable. The third assumption is homoscedasticity which aims to check the homogeneity of the variance of the residuals. The scatterplot in the appendix, which describes the data point patterns between the standardized predicted value and the residuals, indicates that the plot is homoscedastic. As all three assumptions are met, we continue to conduct the regression analysis.

Subsequently, we run the data using multiple regression in SPSS to answer which predictors significantly predict open government implementation. Table 2 presents the summary of the regression analysis. The findings show that among the five independent variables, four of them are found to be significant predictors to open government. The digital skills variable is the only insignificant predictor to open government.

Based on the standardized coefficients, freedom of press is the most important predictor to open government as it has the highest value of standardized coefficients. This predictor also has a positive relationship with open government; an increase of 1 standard deviation of freedom of press will result in an increase of .295 standard deviations of open government. Other important predictors are e-government development and innovation capabilities, which indicate a positive relationship to open government. An increase of 1 standard deviation of e-government will cause an increase of about .298 standard deviations of open government. Similarly, increasing 1 standard deviation of innovation will improve the index of open government by about .298 standard deviations.

Legal adaptability also positively influences the open government index. However, this predictor is considered a weaker predictor to open government. An increase of 1 standard deviation of legal adaptability will likely increase .179 standard deviation of open government.

The digital skills variable, on the contrary, is insignificant as the significance value of this variable is higher than the p-value. Even though it is indicated in the table that this predictor has a negative influence on open government, however, this predictor is not important to explain open government at a global level.

Regarding the goodness of fit, the R-square value is 64.9%. It means that the independent variables in the model explained 64.9% of the variation in the open government index. However, we aim to understand the association between the dependent and independent variables. Therefore, we do not focus on the R-squared value.

Table 2. The summary of regression analysis.

Independent variables	Unstandardized coefficients	Standardized coefficients	Sig
E-government development	.218***	.298***	<.001
Freedom of press	.004***	.392***	<.001
Innovation capabilities	.002**	.261**	.006
Digital skills	−.001	−.101	.299
Legal adaptability	.002*	.179*	.037

R-squared: .649.
Dependent variable: Open Government.
*** p < .001, ** p < .01, *p < .05.

6 Discussion

This article addressed the question, "What factors influence the adoption and implementation of OG at the country level?" As part of its contribution to the empirical literature on open government, the study examines the factors influencing OG implementation at the country level. The multiple regression analysis shows that all factors significantly and positively influence open government, except digital skills. Among the four significant factors, freedom of press and e-government development are the strongest predictors of government openness. Innovation capabilities and legal adaptability are the least strong predictors. Therefore, this result implies that freedom of press, e-government development, innovation capabilities, and legal adaptability are more important for government openness than digital skills.

This study highlights the importance of freedom of press, including freedom of information, transparency, and open government. Our findings strengthen the argument of those who support the role of FOI as an integral component of open government [9]. Our results also support the statement made by the Open Government Partnership [63], which mentioned that access to information and media freedom is essential in open government reforms. Our study implies that a country that aims to achieve open government reforms should address issues that inhibit citizens from freely accessing, consuming, and sharing information. Furthermore, this study also underlines the roles of journalists and media in an open government environment.

The study also supports the notion that ICT is the key to open government [19, 30, 1, 43]. The results demonstrate the significance of e-government development in creating a more open and transparent government for the public. The study proves the existence of path dependence [82] between e-government and open government. A country with progressive e-government development will be most likely to have better open government implementation. Referring to the technical challenges of open government [6], a country with good e-government development could experience fewer technical challenges due to progressive development in e-government. The implication of our study suggests that nations should prioritize e-government development as part of their open government initiatives. E-government development such as improving data and systems integration, the quality of information and data, system usability, and e-customer services.

The study also helps to explain how legal adaptability is important to open government. For a country to have a more open and transparent government, its regulations need to be adaptive to follow the changes in society, including the needs of citizens. For example, in the open government environment, citizens function as service consumers [81], and thus, the government needs to be adaptive in regulations to protect citizens through privacy protection laws and regulations [3]. The study implies the need for government to be adaptive in meeting the rights of citizens to have access to information, including information related to public issues, public utilities, and decision-making processes through laws on the right to access information.

Regarding innovation, our findings complement the existing literature, which stresses that open government has a role in boosting innovation and a nation's competitive advantage [36, 39, 46]. However, the study reveals that the innovation capability of a nation also influences the progress of open government. The findings have two implications. First, a country that demands a transparent and open government should precede firms and private sectors. The government should also emphasize building excellent research. Second, we create a contribution to enrich the literature on innovation and OG. All this time, no study discusses the direct influence of innovation on open government. Our study reveals that innovation can have a direct influence on OG and a direct influence of OG on innovation. To conclude, there is a two-way direction between innovation and open government.

However, we are surprised that this study contradicts previous findings on the importance of digital skills to digital government. A previous study confirmed the relationship between digital skills and citizen involvement in e-government as part of the open government initiative in the European Union. Their study found that digital skills are critical to e-government [75] in a way that differs from ours. Another study also noted the relationship between digital skills and service consumers of government services [57]. Even though we find that e-government development is imperative in open government, our result does not see digital skills as a significant factor for open government. According to our study, no guarantee being digitally literate will lead to open data, services, or engagement on the part of the government. This argument works under the assumption that digital skills may not be the principal driver of a country of open government. In spite of the fact that citizens require literacy, numeracy, and analytical skills, the theoretical reasons for believing that openness leads to education are weaker [79]. The government should encourage the development of critical thinking, problem-solving, and productive, cognitive, and ethical skills among citizens and public officials so that government information can be shared, produced, and consumed.

7 Conclusion, Limitations, and Future Work

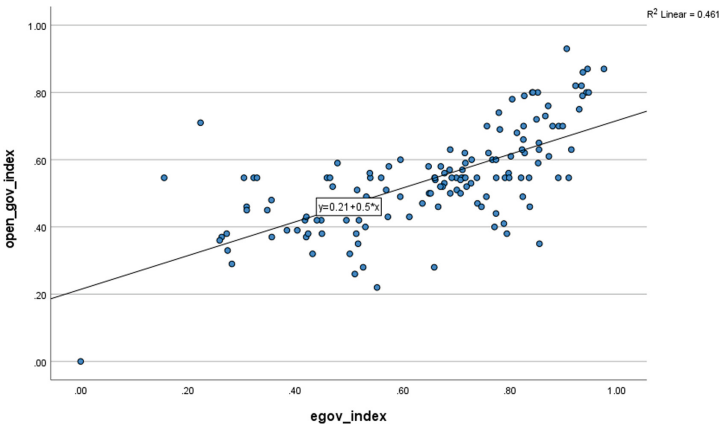
In open government literature, most academic interests focused on the formation, evolution, and institution of open government. Little attention is paid to factors influencing the adoption and implementation of open government globally, with a unique dataset from different universal and reputable world databases. We studied factors that influence open government globally within 137 countries. The paper examines the socio-technical factors that affect open government. The factors are e-government development, freedom of

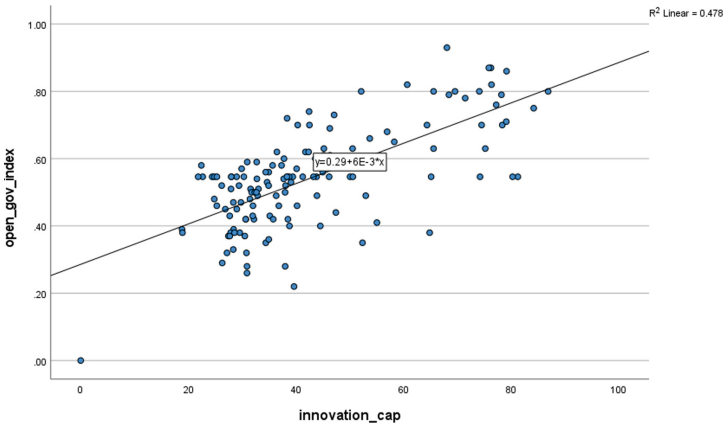
press, innovation capability, digital skills, and legal adaptability. The result confirms that four factors (*e-government development, freedom of the press, and innovation capability*) influenced open government except for digital skills. Past studies have identified digital skills as a barometer for government transparency, data sharing, and citizen engagement. However, this study suggests that digital skills might not be the most influential factor contributing to government openness. In other words, the more citizens and public office holders understand and use digital skills does not determine the level of openness of government in terms of data, services, and citizen engagement. Therefore, we argued that governments worldwide should identify other factors in this study (*e-government development, freedom of press, innovation capabilities, digital skills,* and *legal adaptability*) and use them to drive their openness to data, services, and citizen engagement.

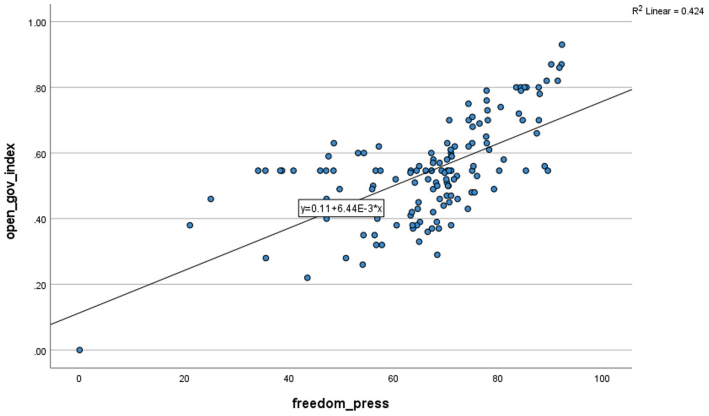
Our research is limited in terms of our ability to disentangle causality; however, our findings offer plausible hypotheses and suggest avenues for further research. Additionally, they give practitioners some insight into how to advance OG globally. As a result of this study, there are two limitations; first, secondary data were collected, which can be analyzed quantitatively or qualitatively in future studies. A total of 137 countries were analyzed, which could be further categorized into developed, developing, and underdeveloped countries. Cities, counties, and states have developed open government initiatives over the past decade. Despite this, there is a lack of empirical research on the factors that affect the implementation of open government at the local and state levels. To understand how state and local governments implement open government initiatives, further research is needed. Further studies can look at these limitations and use them to guide their studies.

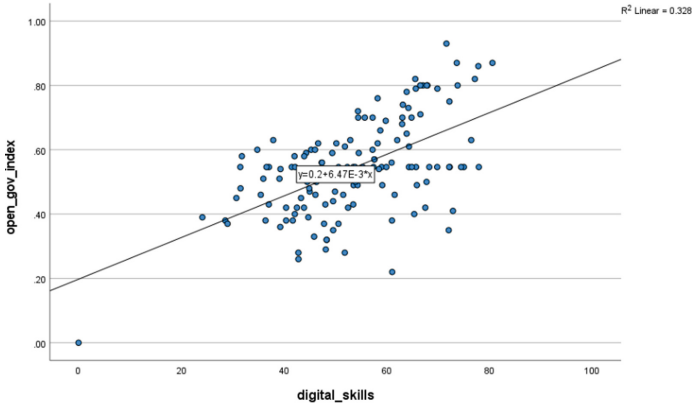
In addition, another limitation is related to handling the missing data. Some papers suggest avoiding missing data imputation using their mean because of bias issues [56, 88]. However, we handle our missing data by imputing them with their means. Therefore, further studies need to be done to find ways to handle missing data using other techniques.

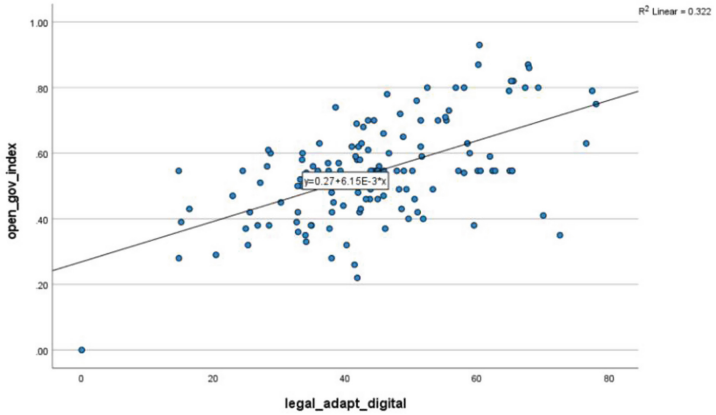
Appendix




R² Linear = 0.478
y=0.29+6E-3*x
open_gov_index
innovation_cap
1.00
.80
.60
.40
.20
.00
0
20
40
60
80
100


R² Linear = 0.424
y=0.11+6.44E-3*x
open_gov_index
freedom_press
1.00
.80
.60
.40
.20
.00
0
20
40
60
80
100

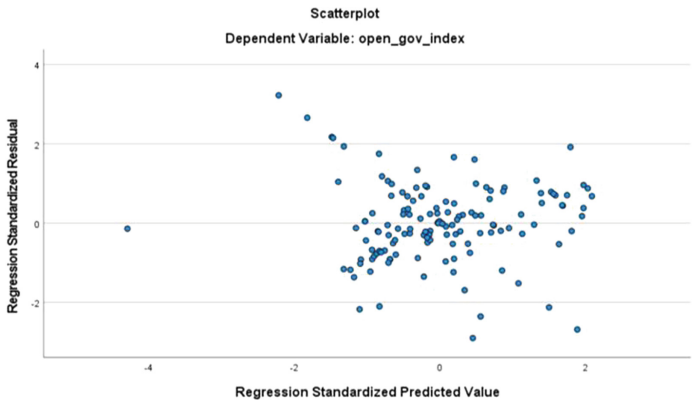

R² Linear = 0.328
y=0.2+6.47E-3*x
open_gov_index
digital_skills
1.00
.80
.60
.40
.20
.00
0
20
40
60
80
100



See Table 3.

Table 3. Pairwise correlations

	Innovation capabilities	Legal adaptability	Freedom of press	Digital skills	E-gov index	Open gov index
Innovation capabilities	1					
Legal adaptability	.716**	1				
Freedom of press	.440**	.440**	1			
Digital skills	.769**	.792**	.320**	1		
E-gov index	.711**	.616**	.405**	.702**	1	



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