

An Empirical Analysis of The Relationship Between E-Government and Corruption in Somalia

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Abstract. This study examines the relationship between e-government implementation and corruption levels in Somalia from 2006 to 2022. Using time series data and econometric techniques such as the autoregressive distributed lag (ARDL) model, augmented Dickey-Fuller (ADF) unit root test, and diagnostic tests, the authors investigate the impact of e-government on corruption. The findings reveal a long-run cointegration between e-government and corruption, with e-government having a negative impact on corruption levels. However, the short-run relationship appears to be positive and statistically insignificant. The study highlights the potential of e-government in combating corruption and improving transparency in Somalia, but also acknowledges the challenges and limitations of relying solely on digital solutions. The authors recommend that Somalia prioritize e-government implementation as part of a comprehensive anti-corruption strategy, while also addressing broader institutional, cultural, and socio-economic factors that contribute to corruption. The study contributes to the growing body of literature on e-government and corruption, providing new insights from the Somali context and underlining the need for further research on the complex interplay between technology, governance, and social change.

Keywords: transparency, e-government, ICT, corruption, Somalia, GDP

1. Introduction

Corruption represents a critical global issue that attracts considerable attention from policymakers, governments, international organizations, and academics due to its detrimental effects on economic development and the establishment of a conducive business environment. Scholars, including Khan et al. (2021) and Mistry & Jalal (2012), define corruption as the exploitation of public office or authority for personal benefit. This phenomenon remains pervasive, with less than half of the 180 evaluated countries and regions scoring between severely corrupt and very clean (100), underscoring its widespread nature, as highlighted by Shareef (2022).

Studies indicate a higher incidence of corruption in Africa compared to other regions, as evidenced by Africa's lowest percentile rank for global corruption control (Onwujekwe et al., 2019; Sedgo & Omgba, 2023). Nigeria is frequently cited as a notable example of a nation significantly affected by corruption, as discussed by Warf (2017). These observations emphasize the formidable challenge of eradicating corruption and underscore the urgent need to address its widespread impact, particularly in regions like Africa, to foster improved governance and economic progress.

Somalia, having endured prolonged civil conflict following the collapse of its central authority, now strives to rebuild itself. However, a significant challenge it faces is the pervasive corruption, which hinders the development of robust institutions and exacerbates political violence (Ahmed, 2021). Transparency International's 2022 Corruption Perceptions Index ranks Somalia as having the lowest level of corruption among 180 countries. Corruption in Somalia manifests in various forms, including bureaucratic bribery, political corruption, and business bribes to government officials and networks (Sofe, 2020). The country's lack of a strong and stable central government, insufficient resources and power, weak leadership, and inadequate compensation for public officials exacerbate these issues (Nur Mohamed et al., 2022). Corruption impedes economic progress, increases inequality and poverty, and adversely affects the quality of life. Addressing corruption in Somalia is crucial for fostering economic growth, reducing inequality, and improving living conditions (Castro & Lopes, 2022).

The prevalence of corruption in Somalia has significantly undermined the effectiveness of humanitarian efforts and the nation's stability. This is evident in the misappropriation of funds allocated for humanitarian relief. Investigations have revealed that a substantial portion of this aid, intended to alleviate suffering and assist the most vulnerable populations, has been diverted through corrupt means. This misappropriation not only deprives those in need of essential resources but also perpetuates cycles of poverty and instability (Sofe, 2020). Additionally, the Marqaati 2022 corruption dossier, released on December 31, 2022, highlighted further instances of financial impropriety, detailing that \$5,936,316.23 in global aid and \$4,543,045.46 in tax revenues were unaccounted for. These revelations have cast doubt on the government's commitment to combating corruption and have intensified scrutiny of its anti-corruption efforts (Marqaati, 2022).

While the relationship between corruption and e-government has shown improvement (Asorwoe, 2014), the adoption of e-government is frequently advocated as a solution to combat corruption (Alam et al., 2023). The United Nations defines an e-government strategy as the utilization of the Internet and the World Wide Web to deliver government services and information to citizens (Kim & An, 2022). E-government initiatives implemented in the public sector have demonstrated success in reducing corruption and enhancing transparency globally, particularly in countries such as Fiji, India, Sub-Saharan Africa, and Iran. Utilizing information and communication technology (ICT) can enhance government transparency and openness, thereby addressing corruption (Darussalam et al., 2021). However, some research findings indicate that the implementation of e-government may not always have a significant impact on reducing corruption (Basyal et al., 2018; Sheryzdanova & Butterfield, 2017). These studies present diverse perspectives on the effectiveness of e-government in combating corruption, highlighting the need for further investigation and nuanced understanding in this area.

Paradoxically, the aforementioned structure may engender new avenues for corrupt practices (Rustiarini, 2019). Given the existence of divergent perspectives, it is imperative to ascertain the extent to which

online government contributes to corruption while emphasizing the need for a deeper understanding of the concept of corruption. Despite Somalia's extensive history of corruption, the Federal Government has long recognized ICT as a key enabler for improved service delivery. The acknowledgment of ICT as a crucial driver in achieving various government strategic development policy goals (Hassan Warsame, 2021) supports this view. This research aims to examine the correlation between the digital government system in Somalia and instances of fraud, focusing on the critical need to combat corruption within the nation. While some studies suggest that the establishment of e-government can mitigate corruption, there are instances where corruption persists despite its adoption. This research analyzes this phenomenon by exploring whether e-government must reach a certain threshold before exerting a beneficial effect on reducing corruption. Other technological, political, and economic factors are considered in the analysis, given the complexity of corruption.

****Hypothesis****

H1: The implementation of e-government reduces corruption levels.

2. Literature Review

Within the extensive literature on e-government and corruption, various approaches have been taken to explore this intersection. However, a significant strand within this field of study aims to examine the relationship between these variables. This particular aspect of the literature delves into understanding and analyzing how e-government initiatives and corruption are interconnected, aiming to uncover the nature, extent, and impact of this relationship.

Theoretical Review

This section introduces the theoretical foundations that underpin the relationship between e-government and corruption. It provides an overview of important theories and frameworks that shed light on how e-government initiatives can potentially combat corruption and promote good governance. Understanding these theoretical perspectives is crucial for policymakers, researchers, and practitioners who aim to leverage information and communication technologies (ICTs) to address corruption and improve public sector performance.

One theory discussed in the document is the "Digital Divide" hypothesis. According to this theory, unequal access to digital technologies and information can worsen corruption in e-government projects. In situations where certain groups or regions lack internet access or digital services, there are disparities in transparency, accountability, and citizen participation in government processes. This creates an environment where corrupt practices can thrive, particularly in areas with weak or inaccessible e-government infrastructure. Additionally, citizens' limited digital literacy can impede their ability to monitor government activities online, making it easier for corruption to occur unnoticed (DiMaggio & Hargittai, 2001). Conversely, another theory, known as the "Transparency and Accountability" Transparency is a fundamental principle of E-Government, involving the open and accessible sharing of information. E-Government platforms enable governments to provide real-time information about their activities, budgets, and decision-making processes. The increased availability of information enhances accountability as citizens can monitor government actions and hold officials responsible for their conduct.

The theoretical investigation into the relationship between E-Government and corruption emphasizes ICTs' ability to positively improve governance. While the theoretical framework predicts that E-Government can help reduce corruption by increasing transparency, accountability, and citizen involvement, careful evaluation of constraints and dangers is required for effective implementation.

2.1 Concept of Corruption

In the last ten years, more attention has been given to studying corruption in e-government research. Corruption means using power wrongly or taking advantage of a job for personal gain (Ijewereme, 2015). It usually happens when governance lacks transparency, accountability, efficiency, and citizen

involvement (Naher et al., 2020). SDG 16 aims to reduce corruption and bribery in many forms (Sartor & Beamish, 2020). The impact of corruption depends on economic freedom, inflation, wealth in society, and political stability (Boardman & Ponomariov, 2022). These factors affect how much corruption happens and how it affects different parts of society and governance.

Corruption in public offices is a serious problem because it greatly affects the values and principles of society and the basics of how a country operates (Sekirina & Mukhametzhanova, 2017). Corruption involves different kinds of illegal activities, including both financial and non-financial gains. These activities might include bribery, extortion, stealing money, fraud, favoritism, and other similar behaviors (Khan & Krishnan, 2019). A study by Karinda et al. (2023) suggests that government corruption is influenced by things like the level of education among people and the government's way of working. This issue is important for public organizations and is a big challenge for the whole country because people care a lot about it and want more openness. Gründler and Potrafke (2019) believe that using electronic systems in the government can make things more transparent, which might reduce corruption.

Hussein's (2019) research highlights how corruption has significantly impacted many government organizations, spanning from local to national levels, as well as safety groups and international bodies. In today's society, nepotism, extortion, and misuse of public resources are commonly seen. Corruption, observed not only in Somalia but also in other places, is a complex issue influenced by economic, social, cultural, and political factors. In Somalia, corruption stands out as a key contributor to the country's instability and political fragility. Alarmingly, there's been a worrying increase in various corrupt practices among public officials in recent times.

These practices involve using public funds for personal gain, demanding bribes for essential services, using connections to secure jobs and political positions, and participating in private business deals to secure public contracts and procurement opportunities (Scek & Issa, 2019). These corrupt behaviors undermine the proper functioning of institutions and harm public trust in governance.

2.2 Concept of E-Government

Hussein's (2019) research shows that corruption has affected many government organizations, from local to national levels, and even safety groups and international bodies. Nowadays, things like favoritism, demanding money, and misusing public resources are quite common. Corruption is a big problem not just in Somalia but also in other places, and it happens because of many things like money, society, culture, and politics. In Somalia, corruption has made the country weak and politically unstable. In recent times, public officials have been involved in many kinds of bad behavior. These include using public money for themselves, asking for money for important services, using connections for jobs and political roles, and doing private business to get government contracts and deals (Scek & Issa, 2019). These actions make governing worse and make people trust the government less.

Implementing sustainable e-governance holds the potential for reducing corruption by improving transparency and accountability in government systems. A promising strategy to achieve this is by using digital systems to manage finances and procurement processes. These systems can help reduce instances of misuse of funds and improve the tracking of transactions (Alam et al., 2023). Additionally, e-governance can improve the flow of information to the public, allowing for greater citizen involvement and oversight of government actions (Banerjee et al., 2020).

A recent assessment by the United Nations on E-government revealed that Somalia ranks lowest globally in compliance with e-government initiatives. Over the years, Somalia's rankings were consistently low, ranging from 193rd to 191st between 2014 and 2020 (Ismail, 2022). However, Somalia's e-government Strategy for 2021 aims to address these issues by outlining how the government plans to utilize its resources—skills, people, knowledge, finances, etc.—to achieve its e-governance goals and objectives.

Efforts have been made to automate government services using various back-end and management information systems. Nevertheless, the adoption of e-government in Somalia has faced several challenges, including internal organizational issues such as rapid technological changes, the digital divide, concerns about security and privacy, meeting citizens' expectations, and ensuring smooth service delivery (Hassan Warsame, 2021). These hurdles have posed significant obstacles to the successful implementation of e-government initiatives in the country.

2.3. Relationship Between E-Government and Corruption

In recent years, governments have introduced various measures to combat corruption, with e-government emerging as a suggested tool. According to Alhammedi (2018), quantitative research conducted on government personnel in Yemen suggests that implementing e-government can potentially reduce corruption and improve transparency in the country's public sector. However, this finding contradicts earlier research on the same topic.

Basyal et al. (2018) conducted a study using panel data from 176 countries between 2003 and 2014. They re-evaluated the relationship between e-government and corruption, considering factors such as per capita GDP, inflation rates, indicators of good governance, and measures of press freedom. Surprisingly, their study found no clear link between the implementation of e-government and the prevalence of corruption. Moreover, there was no empirical evidence supporting the idea that e-government initiatives effectively reduce corruption.

Previous research has sought to investigate the connection between e-government and corruption but has overlooked considering how e-government, along with other contributing factors, might collectively impact corruption. For instance, Oye's (2013) study showcased how the implementation of e-government in Afghanistan effectively combatted corruption and promoted transparency in public administration. In Afghanistan, e-government initiatives were successful in achieving this goal by implementing strategies like minimizing direct interactions between government staff and the public, streamlining administrative procedures, and introducing nationwide online services. These measures aimed to improve the accessibility and convenience of online application processes. Overall, this approach aimed to reduce opportunities for corruption and enhance the efficiency of administrative operations.

The study by Basyal et al. (2018) presents evidence that questions the effectiveness of e-government in decreasing corruption. The authors stress that there might be other influential factors that have a greater impact on levels of corruption. Contrary to the widely accepted belief suggesting a reverse relationship between e-government and corruption, their analysis of a thorough panel dataset revealed no clear connection between electronic governance and corruption. These challenges the commonly held notion that implementing e-government initiatives directly leads to reduced corruption levels.

Several studies have aimed to assess how effective e-government tools are in reducing corruption. For instance, Talab et al. (2019) delved into the relationship between corruption and digital government in both developing and developed nations. Their study had two main goals: firstly, to investigate how e-government affects corruption globally, and secondly, to analyze how the impact of e-government on corruption differs between developing and developed countries using a comparative approach. The researchers built empirical models and validated them to understand the connections between different factors. Their findings suggested a negative correlation between the adoption of information and communication technology (ICT) related e-government initiatives and levels of corruption.

According to Linhartová (2019), there is evidence suggesting a positive link between the adoption of e-government and the extent of corruption. The author's conclusion suggests that in Ethiopia, the introduction of electronic government can explain up to 8.2% of the differences observed in reducing corruption. This underscores the importance of including e-administration as a vital tool in fighting corruption while recognizing its limitations. Additionally, the study finds that many people perceive corruption as widespread within the public sector, leading to negative perceptions about public services. In a study conducted by Adam (2020), the potential of e-government tools in reducing corruption was explored, particularly focusing on the role of ICT and institutional quality as factors. Secondary data from external sources were used, and the results highlighted that the link between e-government and corruption is influenced by the presence of ICT and institutional quality as mediating factors.

Another study by Georgescu (2022) examined the association between e-government and corruption across 27 European nations from 2010 to 2019. Their findings indicated an inverse relationship between the level of ICT implementation in a nation and its corruption levels. These research findings collectively indicate that integrating information and communication technology, along with other factors, plays a role in reducing corruption.

In a study led by Karv (2015) in Estonia, the relationship between implementing online services and the reduction of corruption was investigated. Estonia, known for its progress in adopting e-government initiatives despite being relatively young in the European context, was the focal point of this study.

In their scholarly work titled "The Impact of E-Government on Corruption Mitigation," Tubanambazi and Ruvuna (2021) explore how e-government initiatives are connected to combating corruption. They report that implementing e-government projects has been successful in addressing corruption within national institutions and service systems. The authors argue that the growth of ICT has led to the widespread adoption of e-government by enabling interactions between citizens and the government. This is evident through the use of e-government technologies such as systems for tax payments, voter registration platforms, and portals for license applications. Additionally, the availability of publicly accessible information on the internet allows individuals to access it without cost, enhancing transparency in accessing government services and subsequently reducing instances of corruption. The researchers conclude that the presence of functional e-government systems within a country is associated with lower levels of corruption, citing the case of Singapore as an example.

Alongside Li et al.'s (2021) study, empirical evidence has indicated a U-shaped relationship between e-government and corruption. This suggests that the impact of e-government on corruption varies based on the stages of e-government development as its quality progresses. Sheryazdanova et al.'s (2020) study also supports this idea, finding a correlation between increased e-government prevalence and decreased corruption rates. They observed that as e-government prevalence rose from 10% to 90%, corruption rates decreased from 23% to 10%.

Andersen's (2009) research employed ordinary least squares (OLS) and two-stage least squares (2-SLS) methods to investigate the link between digital government and preventing corruption. Gathering data from 149 countries, the study established a significant association between corruption levels and the implementation of e-government activities.

According to Nizam & Liaqat (2022), their study explored the impact of corruption, foreign direct investment (FDI), and investments on the economy's growth, particularly focusing on the gross domestic product (GDP). The aim was to deeply analyze how corruption, FDI, and economic growth are connected in the BRIC countries—Brazil, Russia, India, and China. They used data from Transparency International's Corruption Perception Index and the World Bank's Statistics database covering the years 1998 to 2017. To examine this relationship, they used time series analysis, conducting unit root testing and panel least squares regression. Their findings revealed a significant negative link between economic growth (measured by GDP) and corruption. This indicates that as corruption rises, GDP tends to decline. Conversely, reducing corruption appears to positively impact

GDP. The study also identified a strong and statistically significant connection between GDP and foreign direct investment (FDI).

In a similar vein, Moiseev et al. (2020) explored the correlation between corruption and economic development using four distinct datasets. Their findings suggested that the impact of corruption on economic growth depends on the existing economic conditions. Corruption was found to impede economic progress in smaller emerging nations, while it seemingly fostered economic growth in newly developed economies in East Asia.

3. Methodology and Data

3.1 Empirical Model

The present study employed an empirical model for investigation by utilizing the autoregressive distributed lag (ARDL). The following Equation represents the practical model:

$$COR_t = f(E-GOV_t, GDP_t) \quad (1)$$

Measuring corruption levels presents a considerable challenge (Andersson & Heywood, 2009). The Corruption Perceptions Index (CPI) was employed as the most effective metric for assessing corruption across all nations included in the study. The Consumer Price Index (CPI) is determined by the collection of responses provided by esteemed business executives who possess expertise in the field. These responses are then used to calculate the average CPI for each respective country while using the Global e-government Readiness Index, later renamed e-government Development Index (EDI), to obtain the measure of a country's e-government. This measure is based on surveys conducted in collaboration between the UN Department of Economic and Social Affairs (UNDESA) and the Civic Resource Group (CRG), a private sector consulting firm providing technology solutions in e-government.

Equation (1) is transformed into natural logarithms as follows:

$$COR_t = a_1 + \beta_1 E-GOV_t + \beta_2 GDP_t + \pi_t \quad (2)$$

Scholarly research suggests that countries adopting information technology or digital government systems tend to display lower levels of corruption. Multiple studies consistently indicate a positive correlation between implementing these technologies and reducing corruption. Furthermore, some investigations propose that nations effectively tackling corruption may witness an increase in their Gross Domestic Product (GDP). Scholars also argue for a negative relationship between efforts to control corruption and economic outcomes.

3.2 Data

The selection of variables and the specific time frame for investigating the correlation between E-government and economic development in Somalia (2006-2022) could be revised by taking into account numerous factors such as data availability, historical significance, and policy importance. The rationale behind the choice of variables and the exact time period might vary depending on the research objectives, data accessibility, and study context. Upon completion of the analysis, scholars are advised to carefully assess these criteria and provide a clearly defined rationale for their choices. The data utilized in the study is obtained from reputable sources, delivering reliable and comprehensive insights into the selected indicators. This research employs time series data spanning from 2006 to 2022 to investigate the connections between E-government and Corruption in Somalia. The dependent variable is E-government, quantified as the e-government Development Index (EDI). The primary independent variable is e-government, measured in index, while economic growth is measured the country goods and services produced with specific period of time. Data sources for this study encompass the UN Development Index, International Perception Index, Statistical, Economic, and Social Research and Training Centre for Islamic Countries (SESRIC), and the World Bank.

The data preprocessing techniques utilized to handle missing data, outliers, and transformations in the examination of E-government and corruption in Somalia may vary depending on the dataset and research objectives. However, there exist certain traditional methodologies that academics may take into account. In this study, in instances where data is missing, researchers can opt for imputation methods or elimination of missing values. The choice of strategies ought to be guided by the specific characteristics of the data and the goals of the study. Furthermore, there are no anomalies present in this investigation.

Prior studies have consistently established E-government as a significant factor influencing corruption (Linhartová, 2019; Basyal et al., 2018; Alhammedi, 2018). Similarly, these studies have indicated that corruption negatively impacts GDP (Nizam & Liaqat, 2022; Moiseev et al., 2020).

3.3 Estimation Technique

In conducting the unit root test, the Augmented Dickey-Fuller (ADF) test method was utilized. This test examined the probability and constant aspects of the results. Unit root tests evaluate the alternative hypothesis of a stationary (or trend stationary) time series against the null hypothesis of a unit root (Zabri & Abu Bakar, 2022).

In the present study, we employ Autoregressive distributed lag (ARDL), which are dynamic econometric models capable of capturing short-term and long-term relationships among variables. ARDL is well-suited for analyzing short-term dynamics, whereas is specifically crafted to investigate long-term equilibrium relationships and adjustment processes in the presence of deviations. Past research efforts might have utilized simplistic models that failed to consider both short-term and long-term dynamics. Noteworthy aspects of this study, including extensive data utilization, application of ARDL, co-integration analysis, dynamic modeling, causal examination, and robustness checks, lead to a more comprehensive and nuanced comprehension of the effects of corruption. Somalia has shown an increase compared to prior surveys, enhancing the credibility and relevance of the findings within academic and policy spheres. The research gap concerning the methodology on E-government and corruption in Somalia stems from the absence of previous studies employing contemporary econometric analysis techniques to explore this correlation. Despite prior investigations on the topic, there exists a necessity for research utilizing advanced econometric methodologies to offer a more rigorous and exhaustive analysis. Furthermore, Contemporary econometric approaches like panel data analysis, time series analysis, and instrumental variable methods enable a more reliable exploration of the causal relationship between E-government and corruption. These techniques can effectively address potential endogeneity issues, consider confounding variables, and produce more dependable estimates of the association. Consequently, this study delves into the dynamic influence of corruption on E-government in the Somali context by employing the Autoregressive Distributed lag (ARDL) within the research paradigm of modern econometric models.

Subsequently, a co-integration test was employed to evaluate the long-term relationship between the variables. According to the Co-integration hypothesis proposed by Engle and Granger (1987), non-stationary variables can be combined linearly to form stationary variables, indicating a co-integrating relationship between these variables.

Conventional methods have faced criticism from Shahbaz et al. (2015) for being biased against rejecting the null hypothesis (no co-integration), showing inconsistency with different order integrated variables, producing significantly misleading outcomes, and being highly unreliable in small sample sizes. To address this, adjustments were made for critical values. To enhance test reliability, a more robust co-integration technique, autoregressive distributed lag (ARDL) bounds testing, was employed. Following the empirical work of Sarkodie & Adams (2018), the ARDL co-integration equation can be expressed

as:
$$\Delta COR_t = \alpha_0 + \beta_1 E - GOV_{t-1} + \beta_2 GDP_{t-1} + \sum_{i=0}^q \Delta \alpha_1 LGDP_{t-k} + \sum_{i=0}^p \Delta \alpha_2 E - GOV_{t-k} + \sum_{i=0}^p \Delta \alpha_2 GDP_{t-k} + \varepsilon_{t-k}$$

Where α_0 is the constant, $\alpha_1 - \alpha_3$ are the coefficient of the short-run variables, β_1 , and β_2 are the elasticity's of long-run parameters, q indicates the explained optimal lags, p shows the optimal lags of the explanatory, Δ is the first difference sign showing short run variables and ε_t is the error term.

The ARDL co-integration method starts with bound testing and then regressed with Ordinary Least Squares (OLS). The null hypothesis $H_0: \beta_1 = \beta_2 = 0$ suggests that variables are not co-integrated the long run, whereas the alternative hypothesis $H_1: \beta_1 \neq \beta_2 \neq 0$ suggests that variables are co-integrated the long run. The null hypothesis tested using the Wald-F statistics and critical values. The null hypothesis is rejected if the Wald F statistics surpass the upper bound critical values, showing that the variables are connected the long run, and vice versa.

The empirical specifications for the model can be quantified as:

$$COR_t = \beta_0 + \beta_1 E - GOV_t + \beta_2 GDP_{t_t} + \varepsilon_t$$

Where COR_t is the dependent variable, where, $E - GOV_t$, GDP_t are the explanatory variables in year t, ε_t is the error term, and β_0 , β_1 , and β_2 are the elasticity's to be estimated.

4. Results and Discussion

4.1 Descriptive statistics

The descriptive analysis provides key statistics including the mean value, standard deviation, and maximum values. The mean value signifies the average, while the standard deviation indicates the extent of variability within the data. Table 1 outlines the descriptive results for the dependent variable, COR. It shows an average value of 2.949976 units, a standard deviation of 0.016106, and a maximum value of 2.963788 units.

Regarding the independent variables—E-GOV and GDP—the mean value for E-GOV is 3.276073 units, with a standard deviation of 0.010500 and a maximum value of 3.285557 units. On the other hand, the average GDP is 15.01346 units, with a standard deviation of 2.868513 and a maximum value of 19.94674 units.

The subsequent step in this study involves conducting a unit root test utilizing the Augmented Dickey-Fuller (ADF) method. This test aims to ascertain whether the data is stationary or non-stationary, assisting in selecting appropriate analytical methods for further analysis.

Table. 1 Descriptive Statistics

	CORRUPTION	E-GOVERNMENT	GDP
Mean	2.949976	3.276073	3.80E+09
Median	2.954243	3.281033	2.43E+09
Maximum	2.963788	3.285557	8.13E+09
Minimum	2.897627	3.257679	1.92E+09
Std. Dev.	0.016106	0.010500	2.47E+09
Skewness	-2.101660	-0.748340	0.954943
Kurtosis	7.639298	1.849517	2.035752
Jarque-Bera	27.76028	2.524259	3.242350
Probability	0.000001	0.283051	0.197666
Sum	50.14959	55.69323	6.45E+10
Sum Sq. Dev.	0.004151	0.001764	9.75E+19
Observations	17	17	17

Source: computed by the authors

Note: probability for all dimensions is zero.

4.2 Correlation Tests

In this study, Spearman pairwise correlations were employed to elaborate on the initial findings. Table 2 displays the coefficients and corresponding p-values for each pairwise variable. Notably, the observed value of 0.59 signifies a significant positive correlation between corruption and E-government. Conversely, there exists a negative correlation of -0.046 between corruption and GDP growth.

Table 2: Pair’s Correlation Matrix

CORRELATION (PROBABILITY)	CORRUPTION	E-GOVERNMENT	GDP
CORRUPTION	1.000	0.5951150562668832	-0.04617975626733008
E-GOVERNMENT	0.5951150562668832	1.000	0.4804199531291088
GDP	-0.04617975626733008	0.4804199531291088	1.000

Source: computed by the authors

4.3 Unit Root Tests

The findings from the Augmented Dickey-Fuller (ADF) test indicate that, except for the CORRUPTION variable, all other variables are non-stationary at the level. Specifically, the E-GOV and GDP variables demonstrate non-stationarity at the level, suggesting they are not of order zero, denoted as I(0). However, the results of the ADF unit root test reveal that all variables show stationarity in the first difference, indicating the absence of a unit root.

The ADF test reveals the presence of a unit root at both the level and the first difference, suggesting that all variables possess a combination of integrated orders of one (1) and zero (0). The subsequent step involves evaluating the ARDL co-integration to assess both short-term and long-term relationships between the dependent variable, corruption, and the independent variables, e-government, and GDP. This will be achieved by employing F-statistics bound tests to examine the long-run relationship and conducting an Error Correction Model test to evaluate the short-run relationship. Additionally, diagnostic tests such as series correlation, heteroskedasticity, and stability tests utilizing CUSUM and the CUSUM of squares will be performed.

Table 3: Unit Root Test

Variables	Level		First difference	
	Intercept	Trend & intercept	Intercept	Trend & intercept
COR	-5.900341**	-5.222238**	-4.437825 **	-3.960796 **
E-GOV	-1.856857	-0.736229	-2.589872 **	-2.875365**
GDP	0.155894	-1.481226	-3.619581**	-3.852755**

Source: computed by the authors

** Symbol shows the four tests ADF is significant at 5% level and first difference of the variables

4.4 Co-integration

This study examines an unconstrained model using the ARDL co-integration test. The F-statistics test is employed to assess the joint hypothesis that all parameters within the lagged long run are equal to zero. The results presented offer robust empirical evidence of an enduring cointegrating association among the variables of interest, with significant implications for comprehending the impact of E-government on combating corruption in Somalia. The selection of the ARDL methodology and the utilization of F-statistics by the researchers seem suitable and well-supported given the information provided. Moreover, the findings offer empirical support for the statistical evidence of long-term co-integration among the variables. The findings indicate that the computed F-statistics of 15.847690 exceed the threshold value of 4.428 at a significance level of 5%. This suggests a significant and enduring relationship between the implementation of E-government and corruption within the context of Somalia. Furthermore, conduct a comparative analysis of the outcomes in relation to preceding research by identifying resemblances and disparities concerning the variables under scrutiny, the methodologies utilized, and the reliability of the outcomes.....

Table: 4 F statistic bound test

Critical value (%)	Lower bound I (0)	Upper bound I(1)
1	5.155	6.265
5	3.538	4.428
10	2.915	3.695
ARDL F-statistics	Wald F-stat 15.847690**	

Notes: * 1% significance level, **5% significance level, *10% significance level.**

4.5 ECM and Short-run Results with Diagnostics

Table 5 displays the short-run estimate results, revealing a positive relationship between corruption and GDP. However, this relationship appears to be insignificant, suggesting that engaging in corrupt practices may not significantly contribute to short-term GDP growth.

On the other hand, E-government demonstrates a statistically significant positive relationship at a 5% significance level with corruption in the first lag. The parameter estimate indicates that when E-government increases by 1%, corruption rises by 0.39% in the first lag.

Table: 5 Short run ECM result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.951890	0.001803	1637.306	0.0000
D(CONV EGOVERNMENT(-1))	1.574549	0.458360	3.435177	0.0056
D(GDP(-1))	5.40E-13	1.61E-12	0.335521	0.7435
ECM	0.390705	0.230366	1.696022	0.1180

Source: computed by the authors

4.6 Diagnosis and Stability Tests

The diagnostic checks conducted on the ARDL model indicate the absence of serial correlation, heteroskedasticity, model misspecification, or normality issues, as presented in Table 6 below. Moreover, the coefficients of the ARDL model have demonstrated stability throughout the sample period, as evidenced by the CUSUM and CUSUM-square tests depicted in Figure 1.

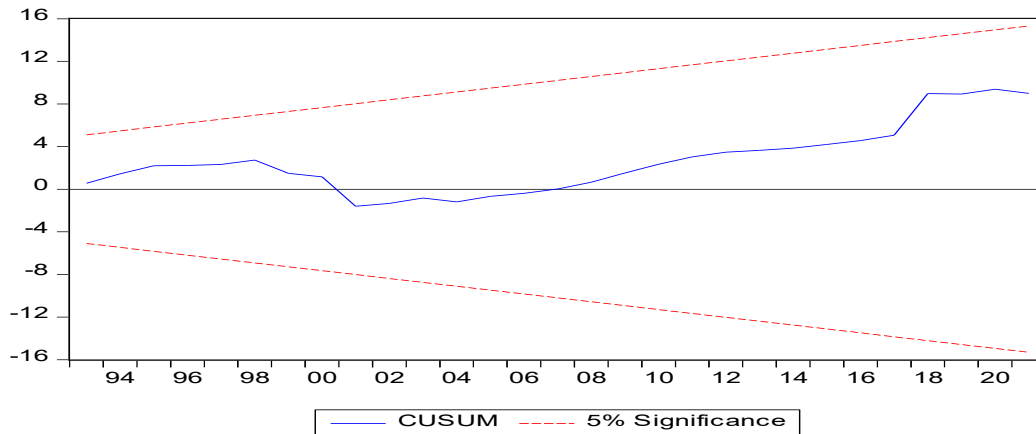
Table 6: Diagnosis Results

Diagnostic Results		
	F-statistic	Prob.
Serial Correlation	0.189145	0.8333
Heteroskedasticity	0.855184	0.5791

Source: computed by the authors

The research also assessed the stability of the estimated model. The results depicted in Figure 1 indicate that both the CUSUM and the CUSUM of squares confirm the stability of the model.

Figure 1: Assessing parameter stability using the CUSUM Test



5. Conclusion and Recommendation

5.1 Conclusion

This study investigates the relationship between e-government implementation and corruption levels in Somalia from 2006 to 2022. Using the ARDL model and other econometric techniques, the authors find evidence of a long-run negative impact of e-government on corruption, suggesting that digital solutions can play a role in promoting transparency and accountability. However, the short-run relationship appears to be positive and insignificant, indicating that the anti-corruption effects of e-government may take time to materialize and require sustained efforts.

The findings highlight the potential of e-government in combating corruption, but also underscore the complexity of the issue and the need for a holistic approach. While digital tools can enhance transparency and reduce opportunities for corrupt practices, they are not a panacea and must be accompanied by broader institutional, legal, and cultural reforms. Somalia faces significant challenges in terms of weak governance, limited resources, and a fragile political environment, which may hinder the effective implementation of e-government initiatives.

To leverage the benefits of e-government in the fight against corruption, Somalia should prioritize investments in digital infrastructure, human capital development, and public awareness. Policymakers should also focus on

building strong institutions, promoting the rule of law, and fostering a culture of integrity and accountability. International cooperation and support from donors and development partners can play a crucial role in providing technical assistance, capacity building, and financial resources for e-government projects.

Future research should aim to address the limitations of this study, such as the small sample size, potential endogeneity issues, and the lack of disaggregated data on e-government initiatives. Qualitative case studies and surveys could provide valuable insights into the specific mechanisms through which

e-government affects corruption, as well as the perceptions and experiences of citizens and public officials. Comparative studies with other African countries could also shed light on the contextual factors that shape the effectiveness of e-government in combating corruption.

5.2 Implications for Practice

The study's findings carry several practical implications. Government bodies in Somalia might consider leveraging E-government initiatives to combat corruption. Strengthening technological infrastructures and promoting transparency through digital platforms can be crucial strategies. Allocation of resources toward bolstering E-government systems and improving their accessibility and functionality could be prioritized. This might involve investments in technology, training programs, and infrastructure development. Understanding the positive relationship between E-government and reducing corruption can guide policymakers in developing targeted anti-corruption strategies. This might involve using digital tools to enhance accountability and transparency in governmental operations. Efforts can be directed towards educating and engaging citizens in utilizing E-government services. This can promote awareness and participation, fostering a culture of transparency and accountability among the populace. Somalia could explore collaborations with international organizations or partners experienced in implementing successful E-government systems. This could aid in adopting best practices and receiving technical assistance for effective implementation. Establishing robust monitoring and evaluation mechanisms for E-government initiatives is crucial. Regular assessments and audits can ensure these systems effectively address corruption and align with intended goals.

5.3 Study Limitations and Recommendations

The amount of data that can be used for this investigation was constrained. Due to this lack of availability, secondary data had to be used, utilizing information that was included in all of the data sources and gathered uniformly by the secondary organizations. The makeup of the aggregated indices and data represents another drawback of this study. Their historical indicators, particularly in light of numerous other country-specific aspects that could potentially impact corruption could not be easily reflected in such a quantitative approach. Shim & Eom (2009); Lindstedt & Naurin (2010); Grönlund & Flygare (2011). The methodology used to calculate these indices can therefore have an impact on the results. Since distinct effects may be produced by diverse variables on an annual basis, these changes should be considered. Future studies should collect accurate data on E-government implementation and corruption. Conducting longitudinal studies over extended periods can help establish clearer causality between E-government initiatives and corruption trends. Employing quantitative analyses with qualitative research methods like interviews or case studies can provide a deeper understanding of the specific contextual factors affecting E-government's impact on corruption in Somalia. Future research should explore additional variables that might influence corruption, such as cultural factors, political dynamics, or governance structures to better understand the relationship between e-government and corruption.

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