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Revisiting the Relationship between E-Government and Corruption: An Empirical Investigation

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This study reinvestigates the relationship between e-government and corruption taking into account some potential methodological problems encountered in multivariate regression models based on the use of cross-country data. Contrary to the stylized fact that e-government reduces corruption, this study finds that e-government has this effect only in combination with gross domestic product per capita which is a very important factor that affects corruption. Moreover, unlike previous studies investigating this relationship, this study includes in its multivariate regression model economic freedom as an important factor affecting corruption. The key finding here is that economic freedom curbs corruption only at high levels of economic development. The interaction of e-government and wealth on the one hand and economic freedom and level of economic development on the other in curbing corruption suggests that there may be synergies associated with these factors in producing this effect on corruption.

Keywords: *e-government, economic freedom, corruption, collinearity, heteroskedasticity*

Introduction

Researchers continue to assess the impact of e-government not only on organizational or administrative values (e.g., efficiency, economy, effectiveness, service quality, etc.) and on political values (e.g., public accountability, citizen engagement, democracy, transparency in government procedures and processes, etc.), but also on the public bureaucracy itself. The potential for e-government to transform the public bureaucracy has prompted some to claim that information technology has engendered a paradigm shift in the practice of public administration, particularly at the municipal level of government (Chadwick and May 2003). Some have even claimed that a shift has occurred from the traditional bureaucratic paradigm to the e-government paradigm (Ho 2002).

In recent years, scholars have investigated the question as to whether e-government has any effect on corruption. The availability of cross-country or cross-national data on individuals' perceptions of corruption, economic freedom, e-government, democracy, rule of law, etc. has provided scholars with data instrumental in the empirical investigation of this research question. More often than not, researchers have used multiple regression models in their assessment of the impact of e-government on corruption. This kind of research methodology is

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fraught with potential methodological problems, particularly collinearity/ multicolinearity, heteroskedasticity, and endogeneity.

Previous studies investigating this research question do not usually pay attention to these problems, notwithstanding their potentially confounding effects on the results of testing their research hypotheses. Nonetheless, a consistent research finding of such studies is that e-government, together with other factors, curbs or reduces corruption in government. This study aims at investigating the effect of e-government on corruption, taking into account these methodological problems. In addition, it uses a regression model that improves on previously used models. Further, the study is based on a random sample, a requirement for regression analysis, which is rarely used in previous studies. The study is divided into four sections. The following section provides an account of the relevant conceptual and empirical literature on e-government, then follows the model of the study, and afterwards a discussion on data and methods. The final section presents data analysis results and conclusions.

Literature Review

The conceptual and empirical literature on e-government has been steadily growing in recent years. The works cited here are simply illustrative rather than being exhaustive. A few strands are discernable in this literature[1]. The strand that is quite relevant for the purpose of this study is the one which investigates the relationship between e-government and certain values which encompass, inter alia, governmental efficiency and effectiveness, public accountability, transparency in government, public service quality, integrity, democratic responsiveness, rule of law, and citizen participation and empowerment (Hazlett and Hill 2003, Holliday and Kwok 2004, Kossick 2002, Netchaeva 2002, West 2004, Wong and Welch 2004, Zhao and Xu 2015, Maerz 2016).

An important portion of this strand is a growing body of literature investigating the relationship between e-government and corruption in government. This strand can be seen as a subset of the much wider investigation into the causes of corruption. Numerous factors have been proposed as determinants of this phenomenon. Economic factors proposed include inflation, gross domestic product per capita, economic freedom, etc. (Paldam 2002, Graeff and Mehlkop 2003, Andersen 2009, Mistry and Jalal, 2012, Elbahnasawy and Revier 2012, Pieroni and d'Agostino 2013, Zhao and Xu 2015). Political factors identified as influencing corruption in government include e-government, size of the public sector, democracy, government regulation, rule of law, law enforcement; political stability, government effectiveness, etc. (Tanzi 1998, Paldam 2002, Kim 2014).

In view of the multitude of factors that may affect corruption and may be affected by it, assertions have begun to emerge underscoring the difficulty in investigating the causes of corruption. A social behavior, corruption may be subject to numerous influences. In its own right, however, it may influence both

[1]For a full discussion on these strands, see Nour et al. (2008).

individual behavior and social institutions. For researchers trying to explain it, this means that their explanatory factors may be influenced by the very same phenomenon that they try to account for. This is well reflected in Treisman's (2007, p. 437) statement that

> Corruption is hard to study empirically. Its many likely determinants interrelate in complicated ways. Some can change quickly and may be caused by corruption as well as the reverse. As with other types of criminal activity, it is hard to observe directly, and so researchers must rely on surveys of corruption's victims, the accuracy of which is often difficult to assess.

In a similar vein, this view is echoed by the IMF perspective on the relationship between corruption and a number of economic variables (e.g., government spending, taxation, economic growth, etc.) that are usually hypothesized as affecting corruption. According to this perspective, corruption affects these variables through its effect on public finance (Hillman 2004).

With respect to the relationship between corruption and e-government, corruption may not only impede the adoption of e-government, it is argued, but may also bring about the failure of e-government projects once they start (Heeks 2003, Aladwani 2016). In a similar vein, Heeks (1999, p. 188) notes that:

> Corruption is a phenomenon rooted in the cultural, political, and economic circumstances of those involved. IT does little to affect these root causes, remains limited in its surveillance potential, and so cannot eliminate corruption.

Notwithstanding the inherent difficulty in studying the causes of corruption, a stylized fact[2] or an empirical generalization has emerged from studies assessing the effect of e-government on corruption. This stylized fact is that e-government reduces or curbs corruption. Yet, studies arriving at this conclusion rarely, if ever, take into account some methodological problems that may confound the results of their studies. These problems arise from the use of aggregate cross-sectional data employed in cross-country studies of the causes of corruption.

One such problem is heteroskedasticity in multivariate regression analysis. This problem makes T-tests and, by implication, hypothesis tests unreliable. Another methodological problem encountered in cross-country studies using multivariate regression analysis is collinearity/multicollinearity. This problem represents a violation of the regression assumption that regressors or independent variables are not correlated. Collinearity of two regressors or multicollinearity of more than two regressors inflate the standard errors of regression coefficients, thereby increasing the probability of rendering those co-efficients statistically insignificant and thus of accepting null hypotheses. Notwithstanding the availability of methods to deal with this problem, previous studies rarely, if ever, employ them.

Both of these problems are important inasmuch as they may lead to erroneous causal inferences. In particular, collinearity may lead to model misspecification

[2]On stylized facts, see Hirschman (2016).

and hence the attribution of erroneous causation (Winship and Western 2016). This study detects and corrects for both of these problems. In dealing with heteroskedasticity, it uses bootstrapping, which is embedded in recent versions of SPSS-PC, for regression co-efficiencts. This method generates heteroskedastic-robust standard errors for regression co-efficients (Flachaire 2005).

Methods and Data

The Empirical Model

A multivariate regression model, based on Ordinary Least Squares, is used here to see if e-government has any effect on corruption, the dependent variable. In view of the numerous factors that affect corruption, any model that aims at explaining corruption has to control for those factors.

The Unit of analysis is country; cross-country aggregate data will be used to assess the effect of e-government on corruption. Unlike previous studies, this study uses a random sample of countries with a view to guarding against sample selection bias. A random process, embedded in SPSS-PC, is used to generate a random sample of 100 countries out of 194 countries which are members of the United Nations Organization. The study estimates the following model:

$$CORR = B_1 - B_2\ EGD - B_3\ ECON.FREE - B_4\ GDP.PC + B_5 POL.INST + B_6\ INFL$$

Where
CORR= Corruption
EG= E-Government
ECON.FREE= Economic Freedom
GDP.PC= Gross Domestic Product Per capita
POL.INST= Political Instability
INFL=Inflation

Dependent Variable

The cross-country measure of corruption that has been used extensively by researchers is the Corruption Perceptions Index (CPI) published annually by Transparency International in Germany. The index does not measure actual experience with corruption; it simply records the opinions or perceptions of individuals about corruption in a country. Another problem with this measure is that it may embody the individualistic or reductionist fallacy[3] in that it makes inferences about countries based on evidence (i.e., individuals' perceptions) gathered from individuals. Notwithstanding these problems, CPI remains the most widely used cross-country measure of corruption. This study uses the 2014 CPI.

Although the CPI is designed to measure a country's level of corruption, a country's score on the index actually reflects how corruption-clean that country is.

[3]On the concept of individualistic fallacy see Nachmias and Nachmias (2000).

The index gives each country surveyed a value or score between 0 and 100. In other words, a high score (e.g., 98) indicates very low level of corruption. Conversely, a low score (e.g., 10) indicates a high level of corruption. For consistency and interpretation of data analysis results, this study transforms the scores for the sample of countries so that high scores indicate high levels of corruption and low scores reflect low levels of corruption. This transformation is achieved by subtracting each country's score from 100. Thus, the 2014 CPI's scores for Denmark and South Sudan are 92 and 15, respectively. After transformation, the scores for Denmark and South Sudan are, respectively, 8 and 85.

Independent Variables

E-government

This is the key explanatory variable of the study. Information on e-government is published by the United Nations in its annual E-Government Development Index (EGDI), which gives each one of its member countries a value that ranges between 0 and 1 inclusive. This index is a composite of three indexes: Online Services Index (OSI), Information and Telecommunications Index, and Human Capital Index. Each one of these indexes also gives each member country a value that ranges between 0 and 1 inclusive.

The study uses the overall E-Government Development Index (EGDI) as a measure of e-government; it is the overall state of e-government development that is expected to curb corruption. It is crucial for the purpose of this study that EDGI encompasses OSI, which is a measure of the extent to which governments provides services and information through their portals. The use of those portals by members of the public does not require any physical interaction with public officials, thereby precluding opportunities for corrupt acts (e.g., taking bribes and kickbacks). Thus, it can be hypothesized that the more developed and extensive a country's e-government is, the less will be opportunities for corruption and the less will be corruption itself. This is related to the rent-seeking hypothesis which, in the context of government regulation, posits that discretionary authority provides public officials with the opportunity to solicit or extract rents (i.e., bribes/ kickbacks) in exchange for desired government services.

Economic freedom

This is an important control factor in the study's empirical model. In general, previous research has demonstrated that, given the level of economic development and wealth, economic freedom curbs corruption (Chafuen and Guzman 2000, Paldam 2002, Graeff and Mehlkop 2003, Pieroni and d'Agostino 2013). This is related to the aforementioned rent-seeking hypothesis in that economic freedom deprives officials of the opportunity to engage in rent seeking.

Surprisingly enough, this important control variable rarely appears, if ever, in multivariate regression models investigating the effect of e-government on corruption. The exclusion of this important variable from such models may lead to model misspecification and, concomitantly, erroneous inferences as to the real causes of corruption. A multi-dimensional phenomenon, economic freedom

encompasses components that preclude opportunities for corrupt practices. In general, this is the case with those corrupt practices that arise from the physical interface between those who seek public services and public officials who deliver those services. A case in point is bribes and kickbacks. A key economic freedom component which obviates the need for such interface is deregulation. The implication here is that economic freedom is a pivotal control variable that cannot be excluded from a model seeking to investigate the effect of e-government on corruption.

Cross-country measures of economic freedom are, as to be expected, multi-national in nature. They usually encompass, inter alia, freedom from corruption, property rights, fiscal freedom, financial freedom, investment freedom, trade freedom, labor freedom, government spending, etc. In this study, economic freedom, conceived as freedom to engage in productive economic activities, is used. Methodologically, this study uses an overall single measure of economic freedom rather than multiple measures of its various components. In previous research, various components of economic freedom were incorporated into single regression models. This is likely to cause the multicollinearity problem, as those components are likely to correlate with each other.

This study uses the 2014 Heritage Foundation Index of Economic Freedom. This index provides a measure of the extent to which economic agents (i.e., individuals and businesses) are free to engage in economic activities. The Foundation's measure of economic freedom combines measures of 10 dimensions: property rights, government spending, fiscal freedom, business freedom, trade freedom, financial freedom, investment freedom, trade freedom, freedom from corruption, and labor freedom. For each one of the more than 180 countries listed, the Foundation provides a score for each one of the 10 dimensions of its measure of economic freedom. In addition, the Foundation's Index of Economic Freedom provides an overall score of economic freedom for each one of those countries. This overall score is simply the average of the 10 scores of all 10 dimensions.

As previously noted, this study uses a single measure of overall economic freedom seen as freedom from government to engage in economic activities. The study excludes freedom from corruption from this measure to avoid endogeneity which will arise if corruption, the dependent variable, is also included in the model as an independent/explanatory variable. In excluding the score for corruption, an average overall score for each country in the sample is obtained by summing all scores for the remaining 9 dimensions and dividing by 9.

Inflation

In the literature (Paldam 2002), inflation is used as a proxy for economic chaos. The so-called chaos or demoralization hypothesis posits that economic chaos has a corrosive effect on public morale and trust in authorities. Corruption was found to have a strong negative correlation with trust in government (Paldam and Svendsen 2000). Therefore, it is hypothesized that the greater the economic chaos or the higher inflation is, the higher will be the level of corruption.

Regardless of being a proxy for economic chaos or not, inflation in its own right may lead public officials to engage in corruption. High inflation reduces real

incomes if nominal incomes (e.g., salaries of public officials) do not increase as inflation increases. Faced with diminishing real incomes during high inflation, public officials may resort to corrupt practices to supplement their incomes. Thus, it can be hypothesized that the higher the inflation rate, the higher is the level of corruption.

Level of a country's wealth

This is an important control variable, as study after study (Treisman 2007, Paldam 2002, Graeff and Mehlkop 2003, Andersen 2009, Saha and Gounder 2013) has found that it reduces corruption, when measured as gross domestic product per capita. Wealthy countries are more likely to have the infrastructural requirements for e-government. Thus, a country's wealth is expected to positively affect the likelihood of adopting Web-enabled transactions for public services (Abdel Rahman 2014). In other words, the wealthier a country is, the more likely that it will have developed e-government. In addition, members of the public in countries with high per capita incomes are likely to have greater access to computers and the Internet than those in countries with low per capita incomes. Accordingly, this predictor is likely to correlate with e-government, and may thereby cause the collinearity problem which may be serious.

For this study, the 2014 gross domestic product per capita at purchasing power parity (PPP) is used to measure a country's level of wealth. The natural logarithm is applied to the values for this variable with a view to guarding against heteroskedasticity problem which is usually expected to be present in cross-national income data. To further guard against this problem, bootstrapping of regression coefficients is used, as previously noted, to produce heteroskedastic-robust standard errors for regression co-efficients.

Political instability

Political Instability appears frequently in the empirical literature as a factor leading to corruption (Treisman 2007, Hillman 2004, Shim and Eom 2008, Pellegrini and Gerlagh 2008). Underpinning the relationship between political instability and corruption is the argument that the former creates conditions of lawlessness that is conducive to corruption. However, the reverse argument has also been made; corruption may also cause political instability (Treisman 2007, Elbahnasawy 2014).This causal relationship appears to be buttressed by a 2015 study on peace and corruption conducted by the Institute of Economics and Peace. The study concludes that increases in police and judicial corruption directly undermine the rule of law, thereby increasing domestic violence and conflict (Institute of Peace and Economics 2015, p. 2). However, limiting corruption in government to only two state institutions (i.e., the judicial system and police) may not capture the full extent of corruption in a country, including those aspects of corruption that may be affected by political instability. For instance, one study has found that political instability motivate officials to embezzle public funds (Campante et al. 2008). Moreover and rather ironically, the study of the Institute of Economics and Peace has found that out of 16 indicators of domestic peace/

violence, political instability is the only indicator that has a statistically significant effect on corruption, though at 0.1 level of significance.

For purpose of this study, whether political instability affects corruption is ultimately an empirical question that needs to be investigated. Data on political instability is obtained from the 2015 Global Peace Index published by the Institute for Economics and Peace. The 2015 Index assigns a score and a rank for each of its list of 162 countries.

Regression Results: Model 1

Table 1 present OLS regression results. As can be gleaned from the table, the model explains more than 70% of the variation on corruption, the R-squared being 0.73. The regression coefficient for EG is in the right direction and statistically significant at 0.01 level of significance. However, it is obvious that there is a severe collinearity problem, as EG correlates strongly with GDP.PC, the correlation co-efficient being 0.87. Moreover, the coefficient for GDP.PC is neither in the right direction nor being statistically significant, probably reflecting the effect of the collinearity problem. The presence of this problem is also confirmed by the variance inflation factor (Table 2) being more than 4 and tolerance value being less than 0.40, the two cutoff threshold values generally accepted in the literature (Carney and Surles 2002).

Table 1. *Regression Results: Model 1*

Independent Variables	**Co-efficients**			**T-Ratio**	**Significance**
	B	**Std. Error**	**Beta**		
(Constant)	47.975	22.452		2.137	0.036
INFL	0.123	0.163	0.051	0.755	0.453
ECON.FREE	-0.153	0.193	-0.068	-0.794	0.430
POL.INST	14.611	2.983	0.370	4.898	0.000
EG	-51.287	12.944	-0.615	-3.962	0.000
GDP.PC	1.246	2.355	0.075	0.529	0.598

$R^2 = 0.73$.

Table 2. *Collinearity Statistics*

Independent Variables	**Tolerance**	**Variance Inflation Factor (VIF)**
Constant		
INFL	0.784	1.275
ECON.FREE	0.498	2.010
POL.INST	0.641	1.559
EG	0.151	6.602
GDP.PC	0.181	5.520

As shown in Table 1, the estimated standard error of the co-efficient for GDP.PC is relatively large, the result of which is to render this co-efficient not statistically significant. Three ways have been suggested to deal with serious collinearity problem (O'Brien 2007): omitting one of the collinear regressors, using ridge regression, or combining the two collinear regressors into a single

index. Ridge regression is ruled out here; it is a biased regression technique (O'Brien 2007).

By the same token, omitting GDP per capita or EG is not followed here because both regressors are important in the model. It makes a lot of sense to combine these two factors in a single index. Combining these two variables into a single index variable is substantively justifiable. Beyond the strong statistical correlation between the two variables, there is, arguably, a substantive relationship between these two factors, particularly in the context of developing countries where individuals with relatively high incomes tend to live in urban areas with greater access to the internet and e-government facilities. It has also been found that countries with high per capita income are more likely to adopt e-government (Abdel Rahman 2014).

Table 1 also shows that the co-efficient for ECON.FREE is in the right direction, albeit it is not statistically significant. In other words, it tends to reduce corruption, though this effect is not statistically significant. This is consistent with previous research (Graeff and Mehlkop 2003). However, when level of economic development is taken into account, economic freedom is shown to have a statistically significant effect on corruption (Graeff and Mehlkop 2003). This method is adopted here in the regression model below.

The regression co-efficient for INFL is also in the right direction, although it is not statistically significant. The level of statistical significance for this co-efficient, as well as those for the other variables, remains unchanged with the bootstrapping of those co-efficients with a view to producing heteroskedastic-robut standard errors for the co-efficients (Table 3).

Table 3. *Bootstrap for Co-Efficients*[*]

Independent Variables	B	Std. Error	Significance
(Constant)	47.975	21.547	0.021
INFL	0.123	.243	0.485
ECON.FREE	-0.153	.182	0.361
POL.INST	14.611	3.456	0.001
EG	-51.287	14.525	0.002
GDP.PC	1.246	2.559	0.626

[*]Bootstrap results are based on 1000 bootstrap samples.

Regardless of the bootstrapping results, a modified model is needed that takes into account the problems with the current model. The following equation presents this modified model (Model 2):

$$CORR = B_1 - B_2\ EG.GDP - B_3\ ECON.FREE - B_4\ ECONFREE.ECONDEV + B_5$$
$$POL.INST + B_6\ INFL$$

Where

CORR= Corruption

EG.GDP= A combined variable of e-government and GDP

ECONFREE.ECONDEV= an Interaction variable of economic freedom and economic development
POL.INST= Political Instability
INFL=Inflation

This new model combines EG and GDP into one variable (i.e., EG.GDP) which is, as previously noted, an index-based variable. The following steps are used in the construction of this index: First, data on GDP per capita for the sample of the study is transformed into an index. This transformation is necessary because GDP per capita and e-government are measured in different units; GDP per capita is measured in dollars whereas e-government has index values. Transforming GDP per capita data into an index standardizes it into the same measurement unit as EG. To achieve this transformation, an average GDP per capita value of all GDP per capita values in the sample is obtained. A GDP per capita index is obtained by scaling down (i.e., dividing) each country's GDP per capita by the average GDP per capita. As should be expected, countries with GDP per capita higher than the average GDP per capita score more than 1 on the GDP per capita index whereas countries with a GDP per capita lower than the average have a value between 0 and 1 on the index. For example, the 2014 GDP per capita (PPP) for the United States and South Africa, which are both in the sample, was US$ 54597 and US$ 13046, respectively. When both of these values are divided by the GDP per capita average of US$ 15561, the United States South Africa score, respectively, 3.5 and 0.84 on the GDP per capita index (Table 4).

The second step in combing EG and GDP per capita is to assign weights to each in the combined index variable. An equal weight of 0.5 is assigned to each one of these variables, the assumption here being that there is no rationale, based either on theory or observation, for assigning differential weights. Finally, an EG.GDP index value for each country in the sample is obtained by summing the values on the EG index and the GDP index for each country and dividing by 2. These two steps are illustrated in Table 4 which demonstrates the sequential construction of the EG.GDP index for 9 selected countries from the sample.

Table 4. *Construction of EG. GDP Index for Selected Countries*

Country	**GDP Per Capita (US$)***	**Average GDP Per Capita (US$)****	**GDP Per Capita Index (2/3)**	**EG Index**	**EG.GDP Index (4+5)/2**
United States	54597	15561.5	3.51	0.8748	2.19
South Africa	13046	15561.5	0.84	0.4869	0.66
Austria	46420	15561.5	2.98	0.7949	1.89
Brazil	16096	15561.5	1.03	0.6008	0.82
Egypt	10877	15561.5	0.70	0.5129	0.61
Ghana	4129	15561.5	0.27	0.3735	0.32
Iceland	43637	15561.5	2.80	0.7970	1.80
India	5855	15561.5	0.38	0.3834	0.38
Nigeria	6031	15561.5	0.39	0.2929	0.34

*2014 GDP Per Capita figures at Purchasing Power Parity.
**Figure represents the average GDP per capita for all 100 countries in the sample.

Model 2 also includes an interaction term for economic freedom and economic development. This interaction is represented by ECONFREE.ECONDEV. Economic development is a dummy variable which takes the value 1 for OECD countries and 0 otherwise. Interaction here is achieved by multiplying the values for economic freedom by those for economic development. In the model, the interaction variable tests the hypothesis that economic freedom in OECD countries has a non-zero effect on corruption. The remaining variable in this new model are the same as those in Model 1.

Regression Results: Model 2

As Table 5 shows, the new model has greater explanatory power compared to the original model. It accounts for nearly 80 percent of the variation on corruption, the R^2 being 0.79 compared to a R^2 value of 0.73 in the original model. Moreover, the serious collinearity problem associated with Model 1 is not encountered in Model 2. However, there is still some measure of collinearity in the latter model, particularly involving ECONFREE.ECONDEV and EG.GDP. However, as shown in Table 6, the VIFs for these two collinear predictors are well below the cutoff threshold value of 4 which is generally accepted in the literature as indicative of acceptable collinearity.

Table 5. *Regression Results: Model 2*

Independent Variables	B	Std. Error	Beta	T-Ratio	Significance
(Constant)	58.836	12.474		4.717	0.000
INFL	0.048	0.144	0.020	0.332	0.741
ECONFREE	-0.219	0.164	-0.097	-1.330	0.188
POL.INST	11.332	2.746	0.287	4.126	0.000
EG.GDP	-12.016	3.129	-0.357	-3.840	0.000
ECONFREE.ECONDEV	-.220	0.068	-0.305	-3.250	0.002

$R^2 = 0.79$

Table 6. *Collinearity Statistics*

Independent Variables	Tolerance	VIF
Constant		
INFL	0.791	1.264
ECONFREE	0.539	1.854
POL.INST	0.597	1.676
EG.GDP	0.333	3.007
ECONFREE.ECONDEV	0.327	3.055

The co-efficient for EG.GDP is in the right direction and statistically significant at 0.01. The negative sign of the co-efficient indicates that the combination of a country's wealth and e-government development reduces corruption. Moreover, the beta for EG.GDP has the largest value among all beta values in the model. This implies that this variable is the most important variable in the model accounting for corruption.

The co-efficient for the interaction of economic freedom and economic development is also in the right direction and statistically significant at 0.01. As previously noted, this is consistent with previous research findings which suggest that economic freedom curbs corruption in countries that have achieved a high level of economic development. The co-efficient for ECONFREE is, as expected, in the right direction, but it is not statistically significant. As previously noted, this is also in line with previous research which suggests that economic freedom alone has no systematic effect on corruption. The relatively large size of the beta co-efficient value (-0.30) for ECONFREE.ECONDEV is second only to the one for EG.GDP, indicating that this variable is the second most important variable accounting for reducing corruption in the model.

As is the case in Model 1, POL.INST has a systematic effect on corruption; its co-efficient is statistically significant at 0.01. It is also in the right direction; political instability increases corruption. By the same token, Domestic inflation tends to increase corruption. However, this effect is random, as its coefficient is not statistically significant at the 0.01 or 0.05 conventional statistical significance levels.

The bootstrap for regression co-efficients in Table 7 displays heteroskedastic-consistent co-efficients for all predictors in Model 2. All co-efficients retain their statistical significance levels shown in Table 5 which displays regression results without bootstrap for regression co-efficients. The bootstrap results suggest heteroskedastic-robust standard errors for regression co-efficients, implying reliable T-tests and statistical inference.

Table 7. *Bootstrap for Co-efficients*[*]

Independent Variables	B	Bias	Std. Error	Significance
Constant	58.836	0.183	10.984	0.001
INFL	0.048	-0.063	0.187	0.677
ECONFREE	-.219	-0.003	0.134	0.087
POL.INST	11.332	0.224	2.738	0.001
EG.GDP	-12.016	-0.542	3.197	0.002
ECONFREE.ECONDEV	-0.220	0.011	0.077	0.006

[*]Bootstrap results are based on 1000 bootstrap samples.

This study reaches the same conclusion drawn by several previous empirical studies investigating the effect of a number of factors on corruption. E-government is but one of several factors that have been reported to affect corruption. However, this study differs in one fundamental respect from other studies which is that e-government curbs corruption only in combination with a country's wealth. The level of e-government development correlates strongly with a country's gross domestic product which is a measure of a country's level of wealth. Substantively, this makes a lot of sense inasmuch as the higher a country's wealth is, the more developed its e-government is expected to be.

The close association of e-government development and growth domestic product makes it very hard to ferret out the true independent effect of e-government on corruption. In view of the cross-national nature of the data used in multiple regression analysis to investigate the effect of e-government and other factors on

corruption, the collinearity problem may be unavoidable. In this study, this problem is quite serious on account of the very strong correlation between e-government development and gross domestic product. In dealing with this problem, the study has combined these two variables into a single index variable. Simple though it may be, this combination is an accepted way of dealing with serious collinearity. Empirical studies using multiple regression models to investigate the relationship between e-government and corruption rarely report, much less deal with, collinearity or multicollinearity which may be found in those models. Nonetheless, the unqualified conclusion of those studies is usually that e-government reduces corruption. Such a conclusion may be unjustifiable if e-government is strongly collinear with other factors. Simply put, establishing a causal relationship between e-government and corruption requires tackling collinearity if it is serious, as it has a potentially confounding effect on establishing internal validity or causality.

Conclusions

This study has empirically demonstrated that e-government, in combination with a country's wealth, reduces or curbs corruption. However, e-government is not the only factor having this effect. To be sure, other factors, particularly economic freedom interacting with the level of economic development, also have this salutary effect. Nevertheless, e-government, in its own right, appears to be at least responsible for some of this effect insofar as it eliminates the physical interaction between economic agents (i.e., individuals and business firms) and public officials. The absence of such an interface forestalls any opportunities for a key component of corruption; namely, bribes and kickbacks.

This salutary effect is the function of transactional e-government or online provision of government services which does not require any physical interface between members of the public and public officials. The policy implication of this effect is fairly obvious; an anti-corruption strategy should embrace a strengthened role for e-government. More specifically, the scope of online services should be widened to include more services. At present, online services are mainly provided for such things as application for car registration, driver licenses, filing tax forms, business licenses, etc. Widening C2G and B2G to incorporate a wider range of web-enabled government services could contribute to promoting efficiency, effectiveness, and responsiveness in government service provision.

An expanded scope for online government services could be a catalyst for expanding the scope of economic freedom. A wider range of online services could provide the impetus for some measure of deregulation which is a key component of economic freedom. E-government could be an effective conduit for good governance insofar as it contributes to curbing corruption in government and facilitating economic freedom which also has the effect of curbing corruption. In other words, e-government could promote good governance directly through reducing corruption and indirectly through facilitating economic freedom which, in turn, curbs corruption.

It is worth noting that providing services to people and businesses through e-government is only one facet in a multi-dimensional approach to curbing corruption. E-government could also provide access to information on government processes and procedures. This imparts transparency to government processes and procedures which, in turn, fosters open and accountable government. Such transparency can be an antidote to corruption, which finds a breeding ground in government processes conducted in secrecy. In other words, e-government should operate in the context of democratic governance which, as Jovanova (2021) points out, requires authentic participation, transparency, and responsibility at all levels of the government.

In passing, it is worth noting that while e-government is a contemporary means of curbing corruption in government, other means were used several centuries ago to tackle government corruption. Thus, in his perceptive discussion on the five ancient criteria of democracy, Papanikos (2022) describes how the process of appointment to public office was used in ancient Athens to protect citizens from corrupt judges. Needless to say, this method of curbing corruption is as relevant today as it was centuries ago.

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