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Corruption and growth in Sub Saharan African countries: Do differences in government effectiveness matter?

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ABSTRACT

Corruption remains a significant global concern and affects economic growth (GDP_{pcg}). Despite extensive research on the relationship between corruption and economic growth in developed countries, the effects of corruption and governance on economic growth in countries in Sub-Saharan Africa (SSA) remain unclear. This study aims to fill this gap in the literature by examining the impacts of corruption, government effectiveness (GEE), and their joint interactive effects on economic growth in a panel of 37 countries in SSA from 2012 to 2022. The data were from multiple sources (the World Bank, the International Monetary Fund, and Transparency International) and analyzed using a two-step generalized method of moments (SGMM) technique. The results of the SGMM demonstrate that corruption has a detrimental effect on the economic growth of countries in the SSA. Furthermore, the findings of the analysis reveal that government effectiveness significantly lowers the economic growth of countries in Sub-Saharan Africa. Most importantly, the results of regression analysis indicate that the joint interactive effect of corruption and government effectiveness ($CPI * GEE$) depresses economies in countries in Sub-Saharan Africa, which is a novel finding. Therefore, this study recommends that in order to support the long-term economic growth of Sub-Saharan African nations, governments should create policies and strategies to combat corruption and improve institutional quality.

Contribution/Originality: This study uses a relatively large sample, the most recent panel data and study period (2012-2022), and the most appropriate estimation technique ($sGMM$) to analyze the data. Finally, the negative effect of the joint interactive effect of corruption and government effectiveness on growth is a novel finding of this study.

1. INTRODUCTION

Corruption is one of the most severe global issues and remains a source of concern (OECD, 2017). Its prevalence is higher in developing countries than in developed countries (Bai, Jayachandran, Malesky, & Olken, 2013). Although corruption is rampant in developing countries, it remains more prevalent in Sub-Saharan- African (SSA) countries, a region with rampant corruption levels worldwide (Nwabuzor, 2005; OECD, 2017). Corruption erodes public trust

and social values, weakens democracy, hinders innovation, widens socioeconomic inequalities, and impedes economic growth (OECD, 2017).

Many studies have examined the impact of corruption on economic growth. For example, Mauro (1995) was among the first to show that corruption negatively impacts growth. According to Mo (2001), corruption has a considerably negative effect on growth. Similarly, Svensson (2005) confirms the negative impact of corruption on per capita income. Tsaturyan and Bryson (2009) examined the effect of corruption on economic growth and concluded that corruption impedes growth. Similarly, Shera, Dosti, and Grabova (2014) reveal that corruption negatively affects per capita income. Many academics have concluded research on this association by employing modern and advanced methods to determine whether the impact holds across all countries. Accordingly, Hakimi and Hamdi (2017), Cieślik and Goczek (2018), Gründler and Potrafke (2019), Farooque, Hamid, and Sun (2021), Afonso and de Sá Fortes Leitão Rodrigues (2022), and Ur Rehman, Bashir, Rashid, and Hussain (2023) indicated that corruption adversely affects growth. Most of these studies support the negative effect of corruption on economic growth.

However, studies have also demonstrated that corruption enhances economic performance under certain circumstances. For example, corruption has enhanced the administrative effectiveness of governmental institutions, increasing economic growth (Chêne, 2014; Huang, 2016). A notable example is that individuals or businesses bribe policymakers to reverse regulations and laws they deem unfavorable, enhancing economic performance (Leff, 1964). Moreover, most of the early studies, for example, Leff (1964), Leys (1965), Lui (1985), Wedeman (1997) and Swaleheen (2011), have found that corruption benefits growth. Additionally, countries have achieved substantial growth despite corruption (Wedeman, 1997). Studies more recent than those aforementioned, such as Chêne (2014), Ondo (2017), Ighodaro and Igbinedion (2020), Spyromitros and Panagiotidis (2022), and Trabelsi (2023), have examined the link between corruption and growth and found a positive impact.

Countries with weak governance, such as those with low levels of GEE, are more corrupt (Shleifer & Vishny, 1993). A notable concern in modern society is the establishment of effective governments that do not exist (Levi, 2006). The effectiveness of the government can safeguard individuals from assault, ensuring the reliability and efficiency of the government and permitting the development and maintenance of the facilities necessary for the provision of services and the interchange of goods (Levi, 2006). Several studies have examined the impact of GEE on growth. For instance, Alam, Kiterage, and Bizuayehu (2017), Güney (2017), Akinbode, Olabisi, Adegbite, Aderemi, and Alawode (2020) and Şaşmaz and Sağdiç (2020) have analyzed the impact of GEE on growth and concluded that it positively affects economic growth. However, these studies have yielded various findings. The variety in the findings is due to differences in the estimation techniques and variables used, differences in the period studied, country-specific coverage, and types of corruption measures (Dreher & Herzfeld, 2005). Most importantly, despite the wide range of evidence on the effects of governance and/or corruption on growth, the impact of corruption,GEE, and their interactive effects on the economic growth of countries in SSA have not been studied; thus, further research is necessary.

This study employs countries in SSA as case studies because corruption is widespread in the region, with a few notable exceptions (Habib & Zurawicki, 2002). The effect of corruption on economic growth in countries in SSA is greater than that in countries in Asia and other developing nations (Huang, 2016). For example, in 2022, the corruption level in SSA was 32/100, below the global average (43) (TI, 2023). As a result, corruption is a hindrance to SSA's economic performance, and it is the most corrupt region in the world (TI, 2023). Thus, understanding the impacts of corruption,GEE, and their joint interactive effect on growth is of particular interest to countries in SSA and would help policymakers design policies that enhance these countries' economies.

This study differs from other studies and contributes to the literature on economic growth in four ways. First, it uses a relatively large sample size (37 countries in the SSA) to examine the impacts of corruption,GEE, and their joint interactive effect on the economic growth rate of countries in the SSA. Second, the $sGMM$ model, the most appropriate estimation technique, is used to analyze the data because it accounts for autocorrelation, endogeneity, heterogeneity,

and omitted variable bias. Third, the inclusion of the joint interactive effect of corruption and GEE as a dependent variable, which has been overlooked in the literature, is the most significant contribution of this study. Fourth, the most recent panel data and study period (2012-2022) are used. Thus, this study aims to fill the aforementioned gaps in the literature by using a $sGMM$ model from 2012 to 2022 to examine the impacts of corruption,GEE and their joint interactive effects on countries in SSA' economic growth.

The remainder of this paper is structured as follows: the next section reviews the literature on corruption,GEE and income; the third section discusses data sources and methods; the fourth section reveals and discusses key findings; and the final section concludes.

2. EMPIRICAL LITERATURE REVIEW

2.1. Effects of Corruption on the Economy

Corruption is a multifaceted phenomenon; thus, establishing a precise, complete definition is difficult. Depending on scholars' schools of thought and approaches to corruption, they have proposed many definitions of corruption. Nevertheless, most definitions of corruption have in common that corrupt conduct entails the abuse of public power for personal advantage. This study adopts the widely accepted definition of corruption: "the use of public office for private gain" (WB, 1997). Much of the empirical research has analyzed the effect of corruption on macroeconomic indicators. However, the results regarding how corruption and GEE affect the economy vary (Mo, 2001; Omrane, 2016; Swaleheen, 2011). The impacts of corruption on economic growth have been categorized into two groups: corruption that benefits or harms economic growth, that is, how it "greases the wheels" or "sands the wheels," respectively. According to the "grease the wheels" perspective, corruption accelerates economic growth, and per the "sands the wheels" perspective, corruption slows investment and, thus, economic growth (Dreher & Herzfeld, 2005).

The literature has shown that corruption affects economic growth. For example, scholars have argued that corruption has a direct impact on growth and functions as a growth deterrent ("sands the wheels") (Bardhan, 1997; Cieślik & Goczek, 2018). Therefore, several studies have indicated the negative impact of corruption on economic growth, but others contend that corruption is able to facilitate growth in regions or countries with weak institutional quality. These varied findings imply that the effects of corruption on growth may be more nuanced and varied among regions or countries than previously thought. Accordingly, a study by Mauro (1995) is regarded as the first empirical research on the impact of corruption on economic growth. Using a sample of 67 developing nations, the author finds that corruption negatively affects economic growth and that corruption lowers growth rates indirectly by reducing the investment rate. Mo (2001) examines how corruption affects governance, human capital, investments, and growth and demonstrates that every unit increase in the level of corruption reduces growth by 0.72%. Thus, as a country's corruption decreases and openness in institutions increases, income growth increases. According to the author, political instability is the most important channel through which corruption harms an economy, accounting for more than 53% of the total effect. Gründler and Potrafke (2019) examine the impact of corruption on economic growth by using 175 countries from 2012 to 2018. They show that corruption affects these countries' economies and that when reversed corruption increases by one-unit, economic growth is reduced by 17 percentage points, which implies the long-term impact of corruption on the economy. Furthermore, Afonso and de Sá Fortes Leitão Rodrigues (2022) analyze whether government size mediates the effect of corruption on the economy by using 48 countries from 2012 and 2019, and according to $sGMM$ regression analysis, corruption negatively affects economic growth.

By contrast, earlier studies than those aforementioned have shown that corruption is beneficial to economic growth in certain cases when more efficient public services are provided without regulations. Corruption acts as a growth stimulant by removing public-imposed investment barriers, which explains the rapid economic growth in Southeast Asian countries. For example, corruption helps businesses and governments avoid costly delays, rigid regulations, and waiting costs (Bardhan, 1997; Leff, 1964; Leys, 1965; Lui, 1985). Leff (1964) finds that corruption enhances growth because some corrupt activities, such as speed money or bribes, might help individuals avoid

bureaucracy and improve the effectiveness of public servants. Bardhan (1997) shows a beneficial effect of corruption on the economies of the countries analyzed: growth rates increase as corruption increases. Furthermore, most recent studies, such as Ondo (2017), have examined the relationship between corruption and income between 2005 and 2015 in the countries comprising the "Economic and Monetary Community of Central Africa" and have found that corruption aids economic growth by "grazing" the administrative burdens that restrict public service access and the progress of privately owned enterprises. Similarly, Shittu, Hassan, and Nawaz (2018) show a positive impact of corruption on the economic growth of countries in SSA. Ighodaro and Igbinedion (2020) use the linear estimation technique to analyze the impact of corruption on economic growth and show the beneficial effect of corruption on economic growth; they also use a nonlinear estimation technique and show that corruption has varying impacts on income growth that depend on its level of intensity. Spyromitros and Panagiotidis (2022) examined the link between corruption and economic growth in 83 developing countries between 2012 and 2018 and showed that the effects of corruption on growth in different regions depend on the intensity of the corruption level. Notably, in Latin American countries, corruption has adversely affected their economies, but in other regions' economies, beneficial impacts on growth rates have been observed. Trabelsi (2023) shows that under the optimal threshold level, a moderate level of corruption has a positive effect on growth, but above the optimal threshold level, high and low rates of corruption reduce growth.

2.2. Effects of GEE on the Economy

Some studies have examined the impact of government effectiveness (GEE) on economic growth. For example, Han, Khan, and Zhuang (2014) use the $sGMM$ to assess whether development performance is affected by governance indices by using data from all countries in the Asian region from 1998 to 2011 and show that corruption control and GEE affect development performance positively. Using 47 countries in SSA between 2002 and 2009, Omoteso and Mobolaji (2014) analyze the link between the control of corruption and governance on the economic growth of countries in SSA and show GEE is associated with regional growth, but corruption positively affected the economic growth of countries in SSA. Similarly, Sacks and Levi (2010) examine the effect of GEE on social welfare by using data from 18 countries in SSA and show that the level of GEE is associated with citizens' capacity to enhance welfare and achieve food security. Using the $sGMM$ method for a panel of 81 countries, Alam et al. (2017) examine the link between GEE and economic growth and show that GEE affects economic growth positively. However, Farooque et al. (2021) study the impacts of corruption and public governance on Gross Domestic Product (GDP) per capita growth rate (GDP_{pcg}), which was used as a proxy variable for economic growth by using 40 SSA and Middle East and North Africa (MENA) countries between 2003 and 2014; they use the $sGMM$ technique and show that a positive effect of the governance index on the economic growth of a country's economy. Akinbode et al. (2020) analyze the effects of GEE and corruption on human development in countries in SSA from 2005 to 2018 and show a positive impact of the GEE on human development. Furthermore, Şaşmaz and Sağdiç (2020) analyze the relationship between GEE and the rule of law on the economic growth of 11 "European Union Transition Economies" between 2002 and 2018 by using a panel data technique and show a positive effect of GEE on the economic growth. Despite the increasing body of literature on the impacts of corruption on economic growth, the findings are varied and inconclusive. Most importantly, the effects of corruption, government effectiveness, and their joint interactive effect on the economic growth of countries in SSA have not been studied. Thus, these issues remain largely unexplored and are a significant research question across multiple disciplines. This study aims to fill some of these gaps in the literature.

3. RESEARCH METHODS

3.1. Data Source

This study employs datasets from 2012 to 2022 from 37 countries in the SSA with balanced panel data. The data is drawn from multiple online databases. The data on GEE are from the World Development Indicator (WDI) data

page of the World Bank (WB, 2023). Data on the corruption perception index (CPI) are from Transparency International, TI (TI, 2023). Data on foreign direct investment (FDI), real per capita GDP, general public spending, investment, population growth rate, and trade openness are from the World Bank, WB (2023), and the International Monetary Fund, IMF (2023). Data availability limits the inclusion of countries and the study period. The list of countries in SSA considered in this study is presented in Appendix Table 1A.

3.2. Definition and Measurement of Variables

This study employs the economic growth rate of real GDP per capita (GDP_{pcg}) as a proxy to measure the economic growth rate of a country's economy, which is a dependent variable (Mauro, 1996; Pellegrini & Gerlagh, 2004). The key independent variables of interest in this study are corruption (CPI) and GEE. CPI is used as a proxy measure of corruption to examine its effect on GDP_{pcg}. The CPI index is extensively used in the literature as a valid proxy for corruption (Setor, Senyo, & Addo, 2021). The World Governance Indicator's (WGI's) "Control of Corruption" has methodological problems. The $TI'SCPI$is frequently regarded as an appropriate measure of corruption because the "ICRG index" deals with the investment risk of corruption measurement rather than corruption (Qu, Slagter, Sylwester, & Doiron, 2019). CPI ranges from 0 to 100, with the lowest values denoting the highest corruption level.

The government effectiveness (GEE) is the other institutional variable included in this study and a measure of institutional or governance quality. The government's effectiveness measures perceptions of the "quality of public services, civil service independence from political pressures, policy formulation and implementation quality, and the legitimacy of the government's commitment to its policies" (Kaufmann, Kraay, & Mastruzzi, 2009). The GEE ranges from -2.5 to 2.5, with higher values reflecting lower public service effectiveness. In addition, public spending (Gov_{exp}), foreign direct investment (FDI_{gdp}), investment rate (Inv_{gdp}), population growth rate (pop_g), and trade openness (T_{open}) are included in this study as control variables based on the theoretical and previous studies obtained from the WB and IMF datasets (Spyromitros & Panagiotidis, 2022; Swaleheen, 2011; Trabelsi, 2023). Table 1 presents the list of variables used in this study.

Table 1. Descriptions of variables and sources of data.

Variables	Description and measurement	Expected effect	Sources
GDP_{pc}	The real GDP per capita (% of GDP)	NA	WB (2023)
GDP_{pcg}	The growth rate of GDP per capita (%)	NA	WB (2023)
$GDP_{pc,2012}$	The initial real GDP per capita (% of GDP)	(-)	WB (2023)
FDI_{gdp}	FDI inflows (% of GDP)	(+)	WB (2023)
Gov_{exp}	General government final consumption expenditures (% of GDP)	(-)	IMF (2023)
Inv_{gdp}	Gross capital formation (% of GDP)	(+)	IMF (2023)
Pop_g	Population growth rate (%)	(+/-)	WB (2023)
T_{open}	Trade openness (% of GDP)	(+)	WB (2023)
CPI_r	CPI, ranging from 0 (Least corrupt) to 100 (Highest corrupt)	(+/-)	TI (2023)
GEE	The government effectiveness ranges from-2.5 to 2.5, with the lowest values denoting the worst governance outcomes	(+)	WGI (2023)

Note: NA denotes not applicable.

3.3. Methods of Data Analysis

In the dynamic structure of this study, in the presence of unobserved country-fixed effects, the adoption of the ordinary least square (OLS) method leads to upwardly biased estimates. This is because of the association of unobserved panel-level effects with the lagged dependent variable, that is, the endogeneity problem (Blundell & Bond, 1998; Hasanović & Latić, 2017). The endogeneity problem can be fixed by using the fixed-effect estimator, but it only

considers within-country differences, thus overlooking cross-country differences. Moreover, conventional fixed-effects methods yield biased estimates of the scalar coefficients of variables (Arellano & Bond, 1991). Arellano and Bond (1991) proposed a new Generalized Method of Momentum (GMM) estimation technique for dynamic panel dataset models. The GMM technique addresses endogeneity, heterogeneity, omitted variable bias, measurement errors, and serial correlation (Ullah, Akhtar, & Zaefarian, 2018). The $sGMM$ estimation technique produces consistent, efficient, and unbiased estimates compared to the difference-GMM because it lowers the bias related to finite samples (Baltagi, 2008). In addition, $sGMM$ uses more instruments than the difference-GMM. Blundell and Bond (1998) and Ullah et al. (2018) reported that the $sGMM$ method produces efficient, consistent, and unbiased estimates and functions better than OLS and fixed/random effects because it accounts for serial correlation, endogeneity, heterogeneity, measurement errors, omitted variable bias, and unobserved panel issues. In addition, when the time sample horizon is short (T) and there are large cross-sections (N) as in this study, the most appropriate model is the $sGMM$ proposed by Arellano and Bover (1995) and Blundell and Bond (1998). Unlike the fixed-effects model used by Ur Rehman et al. (2023) and Spyromitros and Panagiotidis (2022), this study employed the two-step $sGMM$ model to analyse the panel data owing to its advantage over fixed-effects and others similar to the most recent works of Trabelsi (2023), Afonso and de Sá Fortes Leitão Rodrigues (2022), Farooque et al. (2021), and Gründler and Potrafke (2019), among others.

3.4. Specification of the $sGMM$

To analyze the impacts of corruption and GEE on countries in SSA' economies, this study uses the $sGMM$ estimator, expressed as follows:

$$lnGDP_{pcg,it} = \beta_t + \beta_1 lnGDP_{pcg,it-1} + \beta_2 GDP_{pc,it=2012} + \beta_3 CPI_{it} + \sum_{j=4}^{8} \beta_j P'_{it} + v_{it} + \gamma_{it} + \varepsilon_{it} \quad (1)$$

Where: GDP_{pcg} denotes the logarithm of the growth rate of real GDP per capita, $GDP_{pc=2012}$ is the initial level of real GDP per capita, $lnGDP_{pc,it-1}$ is the lagged value of the logarithm of the real GDP per capita, CPI is the level of corruption, P'_i is the set of control variables, β_t is an intercept that varies with time, $\beta_j (j = 1,2,3,\dots)$ are scalar coefficients, v_i is an unobserved country-specific effect (constant across time), γ_{it} denotes the unobserved time-specific effects, which is common across countries, ε_{it} is time-dependent error term, $'i'$ stands for country (i=1,2,3,…N), and subscripts $'t'$ is the time period (t= 2,3,4,…T).

For evaluating the GEE-augmentation effect and its joint interactive impact of corruption, countries in SSA' economies are as follows:

$$lnGDP_{pcg,it} = \alpha_t + \alpha_1 lnGDP_{pcg,it-1} + \alpha_2 GDP_{pc,it=2012} + \alpha_3 CPI_{it} + \sum_{j=4}^{8} \alpha_j P'_{it} + \alpha_9 GEE_{it} + \alpha_{10}(GEE_{it} * CPI_{it}) + \alpha_{11}(Govexp_{gdp,it} * CPI_{it}) + v_{it} + \gamma_{it} + \epsilon_{it} \quad (2)$$

Where: α_t is an intercept that varies with time, α_j $(j = 1,2,3,\dots)$ are scalar coefficients, v_i is an unobserved country-specific effect; and ϵ_t is the vector of residuals. $sGMM$ is computed using the "$xtabond2$" command of Roodman (2009), which also automatically computes instrument validity tests. The robustness test is computed using the $xtreg$ command for $pooled\ OLS$ and the $xtreg$ command supported by $'fe'$ for the fixed-effect model. All statistical analyses are performed using Stata version 17.

4. ANALYSIS RESULTS AND DISCUSSION

4.1. Estimates of Panel Unit Root Test

Testing for the stationarity of the variables included in this study is necessary before conducting an empirical panel data estimation. Pesaran (2007) suggests that variables should be stationary before using panel data estimation techniques. Accordingly, the models of Levin, Lin, and Chu (2002) and Im, Pesaran, and Shin (2003) are employed as panel unit root test models to ensure the reliability of the results. As shown in Table 2, all variables except population growth (Pop_g) are stationary at the levels, implying that no variable differs before the model estimation. Thus, the

estimates of the panel unit root-tests presented in Table 2 indicate that all variables except the population growth rate (I(1)) are stationary at level I(0).

Table 2. Estimates of panel unit root test.

Variable	Test	IPS w-statistics	LLC t-statistics	Status
GDP_{pcg}	Level	-2.34**	-3.25***	I(0)
$GDP_{pc,2012}$	Level	-1.42****	-4.18***	I(0)
Pop_g	First difference	-2.03	1.32	I(1)
T_{open}	Level	-4.12***	-2.22***	I(0)
Inv_{gdp}	Level	-3.65**	4.63**	I(0)
FDI_{gdp}	Level	-1.31***	-3.31***	I(0)
Gov_{exp}	Level	-2.92**	-4.12***	I(0)
CPI_r	Level	-6.81*	-5.14***	I(0)
Gov_{effe}	Level	-3.72***	-4.23**	I(0)

Note: *** p<0.01, ** P<0.05, *P<0.1.

4.2. Descriptive Statistics

Table 3 presents the basic statistics of the variables that were included in this study. On average, TI's corruption perception index (CPI) for the 37 SSA countries was 33.151. The annual average of CPI_r for a country ranges from 15 to 66. On average, the index of government effectiveness (GEE) was -0.705, ranging from -1.887 to 1.161. These figures imply that governance quality was fragile and the level of corruption was very high in SSA countries. On average, the annual per capita GDP (GDP_{pc}) for the sample SSA countries was 2,348.929 US$ for SSA countries, ranging from 261.02 to 16,992.03 US$. Moreover, the average real GDP per capita (GDP_{pcg}) growth rate for the sampled SSA countries is 0.953% per annum. However, it varies remarkably across countries, demonstrating high income differences across the region.

Table 3. Descriptive statistics of variables for SSA countries (2012-2022).

Variable	Mean	Std. dev.	Min.	Max.
GDP_{pc}	2,348.929	3063.129	261.019	16,992.033
GDP_{pcg}	0.953	4.397	-36.778	17.661
Pop_g	2.457	0.829	-0.077	3.867
Gov_{exp}	14.704	6.325	0.000	36.217
T_{open}	425.768	234.300	1.013	808.011
FDI_{gdp}	310.268	177.826	5.011	639.011
Inv_{gdp}	422.357	222.611	1.021	789.011
CPI	33.151	12.094	15.00	66.00
Gov_{effe}	-0.705	0.656	-1.887	1.161
Number of observations	370 (37 countries)			

The estimates of the multicollinearity test show no collinearity among the explanatory variables; thus, the substitutability of these variables is minimal. The reason for this is that the variance inflation factor estimate is less than five (Gujarati, 2004). The estimates of the pairwise correlation matrix also show the absence of multicollinearity Table 4. The ninth row of the matrix reveals a negative association between corruption (CPI) and per capita GDP (GDP_{pc}), growth rates of GDP per capita (GDP_{pcg}), public spending (Gov_{exp}), foreign direct investment (FDI_{gdp}), investment (Inv_{gdp}), trade openness (T_{open}), and GEE. However, it was positively correlated with the population growth rate (Pop_g). The correlation analysis indicates that the estimates between pairs of covariates are relatively low, indicating that multicollinearity is not a problem in the employed model.

Table 4. Estimates of correlation-matrix analysis.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) GDP_{pc}	1.000								
(2)GDP_{pcg}	0.431**	1.000							
(3) Gov_{exp}	0.467**	0.478**	1.000						
(4) T_{open}	0.390**	0.346**	0.335	1.000					
(5)FDI	0.32***	0.439***	0.497*	0.427**	1.000				
(6) Inv_{gdp}	0.314**	0.415**	0.357*	0.317***	0.483**	1.000			
(7) Pop_g	-0.639*	-0.421**	-0.210*	0.379	-0.485	-0.311*	1.000		
(8)Gov_{effe}	-0.363***	-0.317***	0.394**	0.435	-0.337**	-0.252**	0.483	1.000	
(9) CPI	-0.271***	-0.452***	-0.38**	-0.337***	-0.371***	-0.190***	0.288	-0.327**	1.00

Note: *** p<0.01, ** P<0.05, *P<0.1.

4.3. $sGMM$ Estimation Results

The estimates of the two-step $sGMM$ analysis are presented in Table 5 and show the effects of the regressors on countries in SSA's economic growth, with a focus on the impacts of corruption, GEE, and their joint interactive effects on the economies of countries in SSA. More specifically, this study examines three interrelated objectives: i) the effect of CPI on the economies of countries in SSA, ii) the effect of GEE on the economies of countries in SSA, and iii) the joint interactive effect of CPI with GEE on the growth of the economies of countries in SSA.

Based on the overall regression analysis, the F-test statistic ($Prob > F = 0.000$) indicates the overall goodness-of-fit of the $sGMM$ model. Hansen (1982) J-test reveals that the instruments used in this study are not over identified. $sGMM$ passes the Sargan (1958) test, confirming the validity of the parameters that restrict over identification. Moreover, $sGMM$ passes the Arellano and Bond, AR(2) test, which shows the nonexistence of the second-order serial correlation in the error terms Table 5. Furthermore, for assessing the robustness of the findings, fixed effects and pooled OLS techniques are employed.

4.4. Effects of CPI and GEE on the Economy

Table 5 presents the estimates of the effects of CPI, GEE, and their joint interactive effect on, the economic growth of countries in SSA. Model I presents the estimates of the initial regression analysis of all control variables and CPI as a corruption indicator. Model II presents the regression estimates of the variables augmented using GEE in Model I. Model III presents the estimates of the joint interaction of government effectiveness and corruption ($GEE * CPI$) as an independent variable, which was augmented to the Model I variables.

The coefficients of the $sGMM$ regression analysis for CPI show a negative association between corruption and economic growth in countries in SSA (Model I: -0.0437; Model II: -0.0172, and Model III: -0.0021). According to the results, a one-percentage point increase in the corruption level reduces the economic growth rate of countries in the SSA, ranging from 0.0021 to 0.04963 percentage points, *ceteris paribus*. This finding supports the most recent findings of, for example, Hakimi and Hamdi (2017); Cieślik and Goczek (2018); Gründler and Potrafke (2019), Farooque et al. (2021), Afonso and de Sá Fortes Leitão Rodrigues (2022), Spyromitros and Panagiotidis (2022), and Ur Rehman et al. (2023) that corruption adversely affects GDP_{pcg}. However, the findings of this study contradict those of Méon and Weill (2010), Omoteso and Mobolaji (2014), Ondo (2017); Shittu et al. (2018), Ighodaro and Igbinedion (2020), Spyromitros and Panagiotidis (2022) and Trabelsi (2023) who found that corruption positively affects economic growth.

RegardingGEE, the results show that GEE has a negative effect on the economic growth of countries in SSA. Every unit increase in the index of GEE reduces the economic growth rates of countries' economies in the SSA within the range from 0.0019 to 0.0729 percentage points per year. This implies that improving governance practices would increase the economic growth rate of countries in the SSA. This result supports those of Omoteso and Mobolaji (2014), Sacks and Levi (2010), Alam et al. (2017), Güney (2017), Şaşmaz and Sağdiç (2020), and Spyromitros and Panagiotidis (2022), who found that GEE has a negative effect of on economic growth. However, this finding

contradicts those of Kurtz and Schrank (2007), Han et al. (2014), Akinbode et al. (2020), and Farooque et al. (2021), who found a positive effect of GEE on growth. Furthermore, the interaction between corruption and government effectiveness ($GEE * CPI$) negatively affects the economic growth rate of countries in the SSA (0.0331), suggesting that poor GEE exacerbates the detriment to the economic growth of countries in SSA. The level of significance of the interactive term and its negative sign indicates that corruption plays a significant role in the economies of countries in SSA where governance is weak. Moreover, the joint interactive effect of corruption with public spending ($Gov_{exp} * CPI$) on the economic growth of countries in SSA was significant and negative (-0.124). These results support the idea that nations with higher levels of public spending are more vulnerable to the negative impacts of corruption. This suggests that the part of the effect of corruption on economies in SSA countries varies by the level of public spending. Moreover, corruption is expected to substantially affect the economic growth of countries in SSA with high levels of public spending. These results are consistent with those in the literature (Alam et al., 2017; Sacks & Levi, 2010).

Overall, the results of this study indicate that the macroeconomic variables significantly affect the economic growth of countries in SSA. The coefficients of the initial per capita GDP ($lnGDP_{2012}$), FDI inflows, and investment significantly affected the economic growth of countries in SSA across specifications with robust signs. A high initial per capita GDP is associated with a high level of economic growth in countries in SSA. The positive coefficient of the initial level of GDP per capita (0.2333, 0.2658, and 0.2698 using specification models I, II, and III, respectively) shows that a one-percentage point increase in the initial per capita GDP increases the GDP per capita in countries in SSA by 0.2333, 0.2658, and 0.2698 percentage points, respectively, based on specification models I, II, and III. The positive effect of the initial per capita GDP on economic growth in countries in SSA is consistent with that found in other empirical studies (Dreher & Herzfeld, 2005; Pellegrini & Gerlagh, 2004).

The lagged per capita GDP growth rate had a positive and significant effect on the current per capita GDP growth rate. This seems to be a reliable indicator of growth in the economies of SSA countries. Based on specification models I, II, and III, every unit increase in lagged GDP per capita increases the economies in countries in SSA by 0.0784, 0.1021, and 0.1311 percentage points per year, respectively, while holding all other variables constant. This result is consistent with our expectations because countries in SSA are expected to retain greater levels of per capita GDP in the future. This finding is in line with earlier research findings (Akinbode et al., 2020; Gründler & Potrafke, 2019; Trabelsi, 2023), which indicates that lagged GDP per capita affects income growth rate. Likewise, the results indicate that FDI inflows positively and significantly affected SSA countries' economies (Model I:- 0.0986, Model II:- 0.768, and Model III:- 0.0007). According to the results, every unit increase in FDI inflows increases the economic growth of countries in SSA by 0.0986, 0.0768, and 0.0007 percentage points per year in SSA countries based on specification models I, II, and III estimates, respectively while holding all other variables constant. This result is consistent with those in the literature (Gründler & Potrafke, 2019; Hakimi & Hamdi, 2017). Likewise, based on specification models I, II, and III, every unit increase in the rate of investment increases the economic growth of countries in SSA by 0.074, 0.095, and 0.099 percentage points, respectively, *ceteris paribus*. This finding confirms the results of Dreher and Herzfeld (2005), Hakimi and Hamdi (2017), and Spyromitros and Panagiotidis (2022), who found a positive effect of investment on countries' economies.

4.5. Robustness Check

This study uses a Hausman test to identify the appropriate panel data model. The results of the diagnostic analysis indicate that the fixed-effects model is the most appropriate model for the economic growth rate of real GDP per capita (Baltagi, 2008). The diagnostic Hausman test estimates are presented in Appendix, Table 1B. Thus, for the robustness check of the $sGMM$ model estimates, regression estimates are computed using fixed effect and pooled OLS techniques (Roodman, 2009). Accordingly, our primary findings remain unchanged, with all key variables remaining at conventional levels and signs consistent with those reported in Table 5. In particular, the estimate of the lagged

dependent variable using $sGMM$ (logarithm per capita GDP growth rate in this study case) was between the regression estimates of fixed effect and pooled OLS techniques Table 5 and Table 6.

Table 5. $sGMM$ estimation results (Dependent variable: Log real GDP per capita).

Covariates	Model I		Model II		Model III	
	Coef.	P-value	Coef.	P-value	Coef.	P-value
Constant	0.991(0.372)	0.008	0.915(0.424)	0.031	0.595(0.465)	0.201
GDP_{2012}	0.233(0.040)	0.000***	0.266(0.040)	0.000***	0.269(0.039)	0.000***
$lnGDP_{pcg(t-1)}$	0.078(0.043)	0.067*	0.102(0.035)	0.004***	0.131(0.043)	0.002***
Pop_g	-0.069(0.106)	0.514	-0.098(0.423)	0.818	-0.007(0.005)	0.206
Inv_{gdp}	0.074(0.038)	0.053*	0.095(0.039)	0.017**	0.0997(0.039)	0.012**
Gov_{exp}	-0.212(0.150)	0.159	-0.024(0.015)	0.125	-0.043(0.116)	0.785
FDI_{gdp}	0.099(0.039)	0.012**	0.077(0.039)	0.051*	0.001(0.003)	0.007**
T_{open}	0.044(0.046)	0.344	0.001(0.002)	0.760	0.001(0.002)	0.701
CPI	-0.049(0.021)	0.015**	-0.017(0.002)	0.000***	-0.002(0.001)	0.034**
Gov_{effe}			-0.073(0.011)	0.000***	-0.002(0.001)	0.006***
Gov_{effe}*CPI					-0.033(0.004)	0.000***
Gov_{exp}*CPI					-0.124(0.015)	0.000***
Year dummies	Yes		Yes		Yes	
$AR(1)$ (P-value)		0.009	0.017		0.023	
$AR(2)$ (P-value)		0.439	0.725		0.411	
Hansen-test (P-value)		0.572	0.109		0.636	
Sargan-test (P-value)		0.021	0.001		0.043	
No. cross-sections (countries)		37	37		37	
No. of observations		370	370		370	

Note: Standard errors in parenthesis. *** *p<0.01*, ** *P<0.05*, *P<0.1*.

Table 6. Estimates of fixed effect and pooled OLS (Dependent variable: Log real GDP per capita).

Covariates	Dynamic fixed effect		Pooled OLS	
	Coef.	P-value	Coef.	P-value
GDP_{2012}	0.001(0.001)	0.079*	-0.052(0.026)	0.046**
$lnGDP_{pcg(t-1)}$	0.852(0.267)	0.001***	0.481(0.204)	0.018**
Pop_g	-0.013(0.009)	0.149	-0.014(0.017)	0.408
Inv_{gdp}	0.339(0.162)	0.043*	0.353(0.108)	0.001***
Gov_{exp}	-0.004(0.015)	0.822	-0.145(0.192)	0.452
FDI_{gdp}	0.577(0.227)	0.011**	0.105(0.031)	0.001***
T_{open}	0.377(0.164)	0.021**	0.430(0.127)	0.001***
CPI	-0.770(0.371)	0.038**	-0.102(0.035)	0.004***
Gov_{effe}	-1.068(0.504)	0.034**	-1.353(0.408)	0.001***
Gov_{effe}*CPI	-0.002(0.001)	0.045**	-0.674(0.348)	0.053*
No. of observation	370 (37 countries)		370 (37 countries)	
Wald statistics (P-value)	0.000		0.001	
R-squared	0.437		0.313	

Note: Standard errors in parenthesis. *** p<0.01, ** P<0.05, *P<0.1.

5. CONCLUSIONS

Because of the impacts of corruption, government effectiveness, and their joint interactive effect on the economies of countries in SSA are unclear in the literature, this study attempts to fill this research gap by examining 37 countries in SSA from 2012 to 2022. Consistent with findings in the literature, our findings demonstrate a negative impact of corruption on economies in countries in SSA from 2012 to 2022 and a negative impact of GEE on per capita GDP growth rates of countries in SSA. Most importantly, we contribute to the literature that the interactive effects of corruption with government effectiveness and public spending ($GEE * CPI$) and($Gov_{exp} * CPI$) have adverse effects on economies in countries in SSA.

In summary, our findings support the "sands the wheel" hypothesis, a conventional view that corruption adversely affects economic growth. Moreover, despite the variation in the level of GEE across countries in SSA, GEE has a strong negative impact on their economic growth. These results imply that a country in SSA with weak public governance could be fertile ground for the prevalence of higher levels of corruption, significantly lowering the country's economic growth.

Thus, the following critical insights that this study reveals have far-reaching policy implications:

- This finding underscores the urgent need for comprehensive anti-corruption measures and robust governance systems to create an environment conducive to sustained economic growth.
- The interaction between corruption and weak governance exacerbates the adverse effects of corruption on economic growth, emphasizing the importance of strengthening governance structures.
- The negative effect of government effectiveness GEE on the economic growth of countries in SSA further emphasizes the importance of institutional improvements and transparent governance practices.
- These findings collectively suggest that a multifaceted approach involving anti-corruption efforts, governance enhancements, tailored policies, and sustainable growth strategies can contribute to the long-term growth of the economies of countries in SSA.

5.1. Strengths and Limitations

This study possesses both strengths and limitations. Two notable strengths of this study are that interdisciplinary scholars, one from public governance and two from economics, conducted it, and a relatively large sample of countries (N = 37) and sample period (2012-2022) were employed. The three notable limitations are as follows: some countries in the sample might not exhibit the estimated pattern, which is consistent with criticism of using an average panel economic growth; corruption indices are based on perception and are thus subjective; and because of insufficient data, including all countries in SSA was not possible. These limitations indicate that further research should, for example, use methods that enable including all countries in SSA.

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Data Availability Statement: The corresponding author can provide the supporting data of this study upon a reasonable request.
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APPENDIX

Table 1A. List of sample SSA countries.

No.	Country	Abbreviation	No.	Country	Abbreviation
1	Angola	AGO	20	Mali	MLI
2	Benin	BEN	21	Mozambique	MOZ
3	Botswana	BWA	22	Mauritius	MUS
4	Burkina Faso	BFA	23	Namibia	NAM
5	Burundi	BDI	24	Niger	NER
6	Cameroon	CMR	25	Nigeria	NGA
7	Cape Verde	CPV	26	Rwanda	RWA
8	Comoros	COM	27	Senegal	SEN
9	Central African Rep.	CAF	28	Sierra Leone	SLE
10	Cote D'Ivoire	CIV	29	Eswatini	SWZ
11	Dem. Rep. Congo	COD	30	Seychelles	SYC
12	Rep. Congo	COG	31	Chad	TCD
13	Guinea-Bissua	GNB	32	Togo	TGO
14	Gabon	GAB	33	Tanzania	TZA
15	Gambia	GMB	34	Uganda	UGA
16	Ghana	GHA	35	South Africa	ZAF
17	Guinea	GIN	36	Zambia	ZMB
18	Kenya	KEN			
19	Madagascar	MDG	37	Zimbabwe	ZWE

Table 1B: Hausman test for panel data.

Dependent variable	Chi-square	*P*-value	Decisions
GDP per capita ($lnGDP_{pcg}$)	15.89	0.0059	Fixed-effects