Corruption and distortion of public expenditures: Evidence from Africa

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Abstract

This study investigates the effect of corruption on the trade-off between capital and current expenditures in a panel of 48 African countries over the period 2000-2016. Based on statistical yearbooks, we compile disaggregated data on public finances for African countries and find that a high prevalence of corruption distorts the composition of public expenditures at the expense of the share of capital expenditure. Specifically, an increase in corruption by one standard deviation is associated with a decrease in the proportion of capital expenditure from 29% to 16%. The results are robust to various specifications and estimation methods, including the fixed effects and instrumental variables approach. The supportive argument demonstrates that it seems more beneficial for corrupted bureaucrats to manipulate public spending in favor of current rather than capital expenditures. The latter relies on formal and traceable procedures, whereas current expenditure is known to be more open to the use of discretionary allocation.

Keywords: Corruption; capital expenditure; current expenditure; public expenditure; Africa
JEL codes: D73, E62, H5, O55

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1 Introduction

Africa exhibits the lowest percentile rank of control of corruption in the world. According to the World Governance Indicators of the World Bank (2019), the continent is ranked in the 31st percentile in 1996-2018 in control of corruption, while the world average percentile rank is 50th over the same period. In parallel, the GDP per capita of the Sub-Saharan Africa in 2018 is about $1659.95 in constant terms, which is 6.56 times less than the world average (World Bank, 2020). This development gap requires specific investments in human capital, innovation and infrastructure that could be difficult to finance if the constrained resources of African states is mis-allocated through corruption. As an illustrative example, the African Development Bank (AfDB) estimates that Africa is losing about $148 billion, or about 6% of 2015 GDP, each year due to corruption (AfBD, 2015).

Corruption is defined as the abuse of public service for private interests (Shleifer and Vishny, 1993; Treisman, 2000). Even if the theoretical effect of corruption on economic performances is somewhat ambiguous[1], empirical research mainly suggests that corruption negatively affects economic performance (Aghion et al., 2016; Bologna and Ross, 2015; Cooray and Schneider, 2018; Mauro, 1995; Méon and Sekkat, 2005), and one of the underlying mechanisms is the erosion of state capacity.

According to Olken and Pande (2012), corruption distorts public action, increases the costs of public interventions, makes some public projects economically unviable and limits the state's regulatory capacity. In addition, because of the need for secrecy and the differential ease of access to rent, corruption can lead to distortions in public action, including the allocation of public expenditure (Shleifer and Vishny, 1993). Thus, corruption affects the sectoral composition (i.e education, health, defense etc.) of public expenditures, and this has clearly been established by several studies (Delavallade, 2006; Hessami, 2014; Mauro, 1998). However, the potential effect of corruption on the trade-off between capital and current expenditures has rarely been explicitly investigated, and even less so on African states. Consequently, this paper aims to fill this gap.

Specifically, we investigate the distorting impact of corruption on the share of capital expenditure. For this purpose, we compile disaggregated data on public finances for African countries, and using the fixed effects and instrumental variable approach, we test the effect of corruption on the trade-off between capital and current expenditures. The results demonstrate that a high prevalence of corruption distorts the composition of public expenditures at the expense of the share of capital expenditure. This result is in line with our theoretical argument, which is that it seems more beneficial for corrupt bureaucrats to manipulate public spending in favor of current expenditure since the latter is known to be more open to the use of discretionary allocation than capital expenditure, where allocation procedures are more formal and traceable with open tendering.

In its focus on the proportion of capital expenditure, this paper follows the literature on the importance of the trade-off between current and capital expenditures for economic development. According to Barro (1991), capital expenditure is a strategic variable for economic growth and long-term development. Thorat and Fan (2007) also find that public investment lifted more than 500 million people out of poverty in China and India from the 1950s to the late 1990s. For these authors, agricultural productivity growth, the main source of poverty reduction in China and India, has been boosted by public investment in

[1]For the positive effect of corruption, see for example Huntington, 1968; Leff, 1964; Lui, 1985. For the negative effect, see Krueger, 1974; Shleifer and Vishny, 1993.

RD and infrastructures.[2] However, none of these related works examine the relationship between corruption and the trade-off between capital and current expenditures. This paper addresses this gap.

Through the investigation of the effect of corruption on economic variables, this paper follows the strand of the literature that links corruption and economic performance (e.g. d'Agostino, Dunne, and Pieroni, 2016; Lambsdorff, 2003; Mauro, 1995; Wu et al., 2017). However, the mechanisms of action are not well known, particularly regarding African countries. This work highlights one of the channels through which corruption affects economic performance: the distortion of public resource allocation.

To sum up, we posit that by nature, corruption could lead to manipulation of public spending to the detriment of capital expenditure, due to the less discretionary allocation of this type of expenditure. Indeed, capital expenditure is made up of major investment projects whose allocation requires calls for tender, a procedure that limits information asymmetry and increases the risk of sanctions (Cartier-Bresson, 2008). On the other hand, current expenditure is dominated by simplified and more discretionary contracts. Thus, information asymmetry is higher, the risk of punishment is lower and the opportunity for corruption is also higher. We test this proposition on a sample of 48 African countries over the period 2000-2016, and find that a high prevalence of corruption distorts the composition of public expenditures at the expense of the share of capital expenditure. More precisely, an increase in corruption by one standard deviation is associated with a decrease in the proportion of capital expenditure from 29.3% to 16.2%, i.e. 13 percentage points.

The remainder of the paper is as follows. Section 2 briefly reviews the literature on corruption and public expenditures. Section 3 presents the data and methodology devoted to the empirical test. Section 4 presents the results of the effect of corruption on the public expenditures trade-off in Africa. Finally, section 5 concludes.

2 Literature on corruption and public spending

The growth of the African population requires a continuous increase in the provision of public services. From 1960 to 2018, the African population more than quadrupled (4.5 times according the data of WDI (2020)), rising from 283 million to 1.27 billion. In 2018, the population growth rate remains high, at 2.3%. African countries therefore need capital expenditure to increase access to basic public services. This situation calls for an understanding of the factors behind the allocation between capital expenditure and current expenditure.

To date, several studies have explored the link between corruption and public expenditure, focusing specifically on the sectoral composition. The main result is that corruption distorts public spending in favor of sectors where opportunities for corruption are greater, at the expense of the optimal allocation of public resources (e.g., Delavallade, 2006; Mauro, 1998). In a sample of 64 developed and developing countries over the period 1996-2001, Delavallade (2006) finds that corruption distorts public spending to the detriment of the social sectors (Education, Health, Social Protection) and in favor of the public service and security, culture, fuel and energy, and defense sectors. These results are also found by Mauro (1998) for education and Gupta, De Mello, and Sharan (2001) for defense. In a sample of 120 developed and developing countries over the period 1985 to 1998 with

[2]Such as roads, irrigation, electricity, communication and education

cross-sections and panels, Gupta, De Mello, and Sharan (2001) show that corruption increases the share of the military sector's spending and arms procurement as a share of total expenditures and GDP.

More recently, Hessami (2014), on a sample of 29 OECD countries over the period 1996 to 2009 also finds that corruption increases the proportion of spending on health and environmental protection. An increase in corruption by one unit is associated with an increase of 0.39 and 0.07 percentage points respectively in the share of expenditures allocated to the health and environmental protection sectors.

On the other hand, a second strand of the literature shows that corruption affects public investment as a share of GDP. Tanzi and Davoodi (1997, 1998), Keefer and Knack (2007) and Baliamoune-Lutz and Ndikumana (2008) explore the impact of good governance on public investment as a proportion of GDP. In a sample of developed and developing countries, in cross-sectional terms over the period 1974-1998, Keefer and Knack (2007) find that public investment (as a percentage of GDP and total investment) is high in countries with poor governance quality. According to Keefer and Knack (2007), this result indicates that governments are using public investment to increase their rent opportunity. In addition, Baliamoune-Lutz and Ndikumana (2008) argue that corruption positively affects public investment as a percentage of GDP.

However, looking more deeply, recent studies exhibit a threshold effect on this relationship. For example, Palguta and Pertold (2017) indicate that public procurement values are manipulated to stay below the tender requirement threshold in a study on public procurement in the Czech Republic. Their analysis, based on data from 45,000 contracts with a value of more than US$52 billion in the Czech Republic, shows that the introduction of the threshold above which competitive tendering is mandatory leads to a distortion in public procurement with a grouping just below the threshold, particularly for works and service contracts whose real value is difficult to predict. The authors also find that market manipulation is associated with an increase in the likelihood of contracts being awarded to anonymous firms. Palguta and Pertold (2017) interpret this behavior as an attempt by public officials to hide their rent-seeking behavior. In the same vein, Coviello and Mariniello (2014)'s analysis shows that the publicity requirement, which is often associated with the tender threshold, fuels competition and reduces the public bill in the case of Italy. Their empirical work focuses on 17,512 public contracts with values between 200,000 and 800,000 euros, with a publicity threshold of 500,000 euros.

The contribution of this study is to determine how corruption affects the trade-off between capital and current expenditure in African countries. This purpose is not present in the aforementioned studies. Specifically, the paper aims to understand the extent of the distorting impact of corruption in terms of a composition, which is crucial for developing countries since capital expenditure is strategic to economic development (Barro, 1991). The rationale is that because of the need for secrecy of the practice of corruption (Shleifer and Vishny, 1993), it could lead to a distortion of the structure of public spending at the expense of capital spending. The allocation of capital expenditure is less discretionary than current expenditure.

3 Empirical analysis

As indicated above, this paper investigates the impact of corruption on the structure of public spending. For this purpose we rely on the following equation:

$$CEP_{it} = \alpha_0 + \beta_1 Corruption_{it} + \gamma X_{it} + \mathbf{C}_i + \mathbf{T}_t + u_{it} \quad (1)$$

CEP (Capital Expenditure Proportion) refers to the share of capital expenditure in total expenditures or in current expenditure. *Corruption* refers to the corruption indicator and X_{it} is a set of explanatory variables. $\boldsymbol{C}_i$ represents the country-specific effect and $\boldsymbol{T}_t$ the temporal fixed effect. In the following, we present the data and the variables.

3.1 Data

Our sample covers 48 African countries over the period 2000 to 2016. Based on statistical yearbooks of the African Statistical Coordination Committee (ASCC), we compiled disaggregated data on public finances and inflation for African countries. The ASCC was set up by the African Development Bank (AfDB), the African Union Commission and the United Nations Economic Commission for Africa. Public finances data are expressed in local currency. Since we are interested in the structure of public spending, this does not influence our results.

Data on corruption and democracy come from the World Bank's World Governance Indicators database and Political Risk Services (PRS), respectively. The lack of data on corruption for 2001 is offset by averaging those for 2000 and 2002.

We use World Development Indicators (WDI) data for the other explanatory variables. These include GDP per capita in purchasing power parity, the share of the population aged 0-14 years, the share of the urban population, the net official development assistance per capita, the proportion of the population with access to electricity, and the share of natural resource rents in GDP. The descriptive statistics of all variables are provided in table 1. The data show a relatively low dispersion for the corruption index and capital expenditure (% of total). The minimum level of corruption is 0.26 and the maximum is 0.86 on a scale of 0 to 1. Its standard deviation is 0.12. Capital expenditure (% of total) shows a minimum of 1.5% and a maximum of 87.8% with a standard deviation of 14%.

3.2 Variables and descriptive statistics

We now examine our variables of interest: corruption and the proportion of capital expenditures (% of total expenditures or % of current expenditure). In addition to these variables, several explanatory variables are taken into account for the empirical strategy.

Measuring corruption

An ideal measure of public corruption could be the frequency or amounts of bribes exchanged per year in a country between private agents and public officials based on direct observation. Indeed, Olken and Barron (2009) and Sequeira and Djankov (2014) provide cases of direct observation of bribe payments by truck drivers at checkpoints in Aceh province in Indonesia and at the ports of Maputo in Mozambique and Durban in South Africa respectively. However, such direct observation data are rare due to the nature of corruption and the need for secrecy. The literature therefore uses approximation measures.

Olken and Pande (2012) identify five strategies: (i) Measurement through a survey of companies or individuals who pay bribes. This measure was used by Svensson (2003) to estimate the cost of bribes on businesses in Uganda; (ii) the subtractive corruption estimate, which is the difference between the amount before and after corruption. This method was used by Reinikka and Svensson (2004) to estimate the erosion of funds between their release by the central government and their receipt by schools, by Fisman and Wei (2004) to measure tax evasion in China and by Olken (2007) to estimate corruption in the road sector in Indonesia; (iii) the third strategy is to estimate corruption based on market equilibrium theory and data on market activities (Fisman, 2001); (iv) the fourth measure is the use of audit data (Bologna and Ross, 2015) and (v) the last measure uses perception surveys (T. S. Aidt, 2009; Keefer and Knack, 2007; Mauro, 1995). These approximation strategies have led to spectacular progress in the empirical study of corruption, particularly at the macroeconomic level.

For this study, we use perception data such as the World Bank's World Governance Indicators as a proxy for corruption. The World Bank's World Governance Indicators assess the quality of governance through survey data from companies, experts and citizens in developed and developing countries (WGI, 2019). Corruption here "reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as capture of the state by elites and private interests" (WGI, 2019). The measurement of corruption through perception is relevant, especially when the study is about public institutions (Cooray, Dzhumashev, and Schneider, 2017). We prefer World Bank indicators to other indicators, due to its availability for all countries in our study sample and its relative suitability for our data profile. However in robustness checks, we use other sources of the corruption variable, including the V-Dem Dataset (Coppedge et al., 2019).

The control of corruption is measured on a scale from -2.5 (high level of corruption) to 2.5 (no corruption). To facilitate the interpretation of the results, the indicator is transformed [3] on a scale from 0 (no corruption) to 1 (high prevalence of corruption). Over the period 2000 to 2016, the least corrupt countries on average are Botswana (0.31), Cape Verde (0.35) and the Seychelles (0.42), while the most corrupt countries are Equatorial Guinea (0.81), the Democratic Republic of Congo (0.78) and Chad (0.77). The average corruption rate of the study sample (0.62) over the period 2000-2016 is above the average of the indicator (0.5), suggesting that corruption levels are above average in Africa.

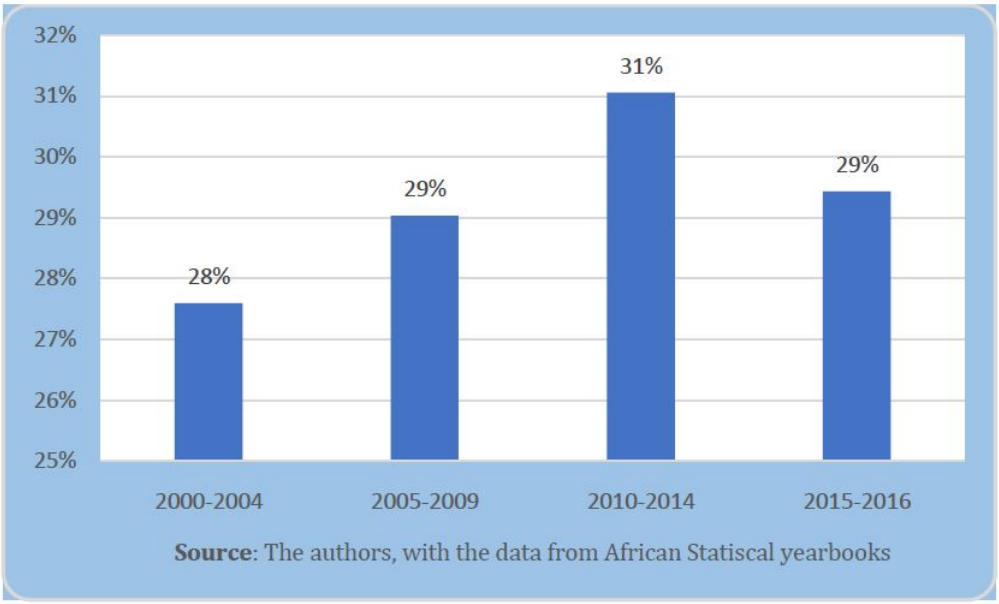
Dependent variables

The proportion of capital expenditure in total expenditures and net lending is our dependent variable. It corresponds to the "expenditures for acquisition of fixed capital assets, stocks, land or intangible assets plus unrequited transfers for the purpose of permitting the recipient to acquire such assets." These assets must be intended for use for more than one year in the process of production (ASCC, 2018). Over the period of study, the average capital expenditure share is 29.3% of total expenditures and net lending for the whole of Africa. **Figure 1** shows that the proportion of capital expenditure increases over the period 2000-2004 to 2010-2014 from an average of 28% of total expenditure to 31%. However, it begins to decline from the 2010-2014 period onwards, falling to 29% over the 2015-2016 period. South Africa (5.5%), Egypt (12%) and Mauritius (13%) have the lowest shares of capital expenditure while Equatorial Guinea (71.8%), Sao Tome and Principe (49.5%) and Ethiopia (47.2%) have the highest shares of capital expenditure.

[3] by applying this formula: (Max(Control of corruption)- Control of corruption)/(Max(Control of corruption)-Min(Control of corruption))

We also use the proportions of capital expenditure in the current expenditure as dependent variable for the robustness check. Current expenditure "includes all non-repayable payments by government, whether requited or unrequited, other than capital expenditure or grants"(ASCC, 2018). They include wages and salaries, and operating expenses among others. South Africa (96.1), Sudan (89.2%) and Egypt (87.6%) have the highest shares of current expenditure (% of total expenditures and net lending). The lowest shares are recorded in Equatorial Guinea (28.2%), Sao Tome and Principe (49%) and Ethiopia (52.5%). The average of the sample is 70% of total expenditures.

Figure 1: Capital expenditure share (% of total) in Africa over the period 2000-2016



The control variables

The control variables include economic variables (GDP per capita, tax effort, inflation), demographic variables (share of population aged 0-14 years, share of urban population), a variable indicating the level of infrastructure in the country (share of population with access to electricity) and three variables indicating natural resources abundance (natural resource rents to GDP), net official development assistance (ODA) and democracy (democracy).

3.3 Identification strategy

We estimate the impact of corruption on the proportion of capital expenditure through equation (1).

Our focus is on the distorting effect of corruption on the composition of public expenditure by economic function. According to Delavallade (2006), the allocative effect of corruption only appears when one looks at the fiscal structure. Thus, we relate capital expenditure to total expenditures and net lending instead of GDP. The ratio of public expenditure to GDP can be broken down as follows:

$$\frac{CE}{GDP} = \underbrace{\frac{TE}{GDP}}(1) * \underbrace{\frac{CE}{TE}}(2) \tag{2}$$

(1) serves to measure the expenditure effect; (2) serves to measure the distortion effect

Table 1: Summary statistics for all countries in the sample

	N	Mean	Std. Dev.	Min.	Max.
Capital expenditure (% of total expenditure)	816	29.25398	13.96435	1.471176	87.79011
Corruption	816	.6152653	.1181479	.2566526	.8611746
Tax revenu (% of GDP)	814	18.19484	9.263828	4.069502	62.46405
GDP per capita (PPP)	799	4958.814	5990.59	545.6888	40015.82
Inflation rate	816	8.532843	25.91259	-9	550
Population from 0 to 14 (% of total)	816	40.97691	6.589149	18.9088	50.23148
Urban population (% of total)	816	41.28419	17.47065	8.246	88.559
Net ODA per capita	816	65.21754	75.39738	-11.96667	691.9246
Access to electricity (% of total population)	816	41.29958	29.78109	2.902384	1005
Natural resource rents (% of GDP)	808	12.33562	12.10461	.0011475	61.94497
Democracy	771	-.0985733	18.26253	-88	10

With CE= Capital Expenditure, TE= Total Expenditures et GDP= Gross Domestic Product

We calculate the proportion by relating capital expenditure to total expenditures and net lending.

We expect corruption to negatively affect the proportion of capital expenditure, highlighting its distorting effect on public expenditure at the expense of capital expenditure. We also expect a negative effect of GDP per capita, which measures the level of development, of inflation, which is an indicator of economic conditions, and of the proportion of the population with access to electricity, which measures the level of infrastructure in the country. Indeed, the more developed a country is, the more likely it is to increase its current expenditure and invest less in infrastructure. In addition, in times of poor economic conditions, capital expenditure acts as an adjustment variable, particularly in developing countries (Bhattacharyya and Collier, 2013).

The tax effort (tax revenues as a percentage of GDP), the proportions of the population aged 0-14 years and the urban population and democracy should positively affect the proportion of capital expenditure. An increase in the tax effort loosens the budgetary constraint and therefore favors the allocation of public expenditure to capital expenditure. The higher the proportion of the population aged 0-14 years, the greater the need for school construction and therefore for an increase in capital expenditure. A high proportion of the urban population in developing countries favors capital investment. Indeed, it has significant power to demand investment from the political authorities since in Africa, power is regularly lost due to the urban constraint (e.g. Burkina Faso in 1966 and 2014, Algeria and Sudan in 2019). Democracy should favor an optimal allocation of public expenditure, i.e. in favor of the proportion of capital expenditure to the detriment of

current expenditure.

Natural resource rents are expected to have a negative effect on the proportion of capital expenditures. Indeed, the work of Bhattacharyya and Collier (2013) shows that natural resource rents reduce the public capital stock, highlighting a "policy-based curse". This effect can occur through three channels: (i) weak monitoring of public resource management (Collier and Hoeffler, 2009), (ii) selection of unscrupulous politicians (Bhattacharyya and Collier, 2013), and (iii) voracity in the case of a power contest between rival groups in a context of weak rule of law (Tornell and Lane, 1999).

However, a potential problem that could bias our results is the other forms of endogeneity, including dual causality and measurement errors. Indeed, while corruption affects the structure of public expenditure, one can argue that the allocation of public resources to high-rent activities can create a favorable situation for the exchange of bribes. Second, since we use perception data, the measurement of corruption can be biased by the country's economic performance.

To counter this potential problem and identify the causal effect, we estimate the equation using the instrumental variable method (the two-stage least squares estimation). This method has the advantage of not being sensitive to the specification of the endogenous explanatory variable (Dong and Lewbel, 2015; Lewbel, Dong, and Yang, 2012). To do this, accountability is used as an instrument. This instrument has been used by T. Aidt, Dutta, and Sena, 2008, and T. S. Aidt, 2009, to measure the impact of corruption on economic growth. According to T. Aidt, Dutta, and Sena (2008), rulers have an incentive to extract the maximum amount of rents, and society, whether democratic or not, develops institutions to hold them accountable and reduce corruption. In democratic societies, elections play this role and in non-democratic societies constraints can appear in the form of the threat of putsch or popular revolt, as noted by Acemoglu and Robinson (2001). For example, in South Africa, Jacob Zuma was ousted from power in February 2018 due to corruption. The Nkandla scandal (the renovation of Zuma's private residence with public funds), his collusion with the Gupta family with the awarding of public contracts are among other elements of corruption that led to his downfall.

A good instrument must have two characteristics: it must be strongly correlated to the explanatory variable suspected of endogeneity, and must influence the explained variable only through its effect on the endogenous explanatory variable. We expect accountability to be negatively correlated with the corruption variable.

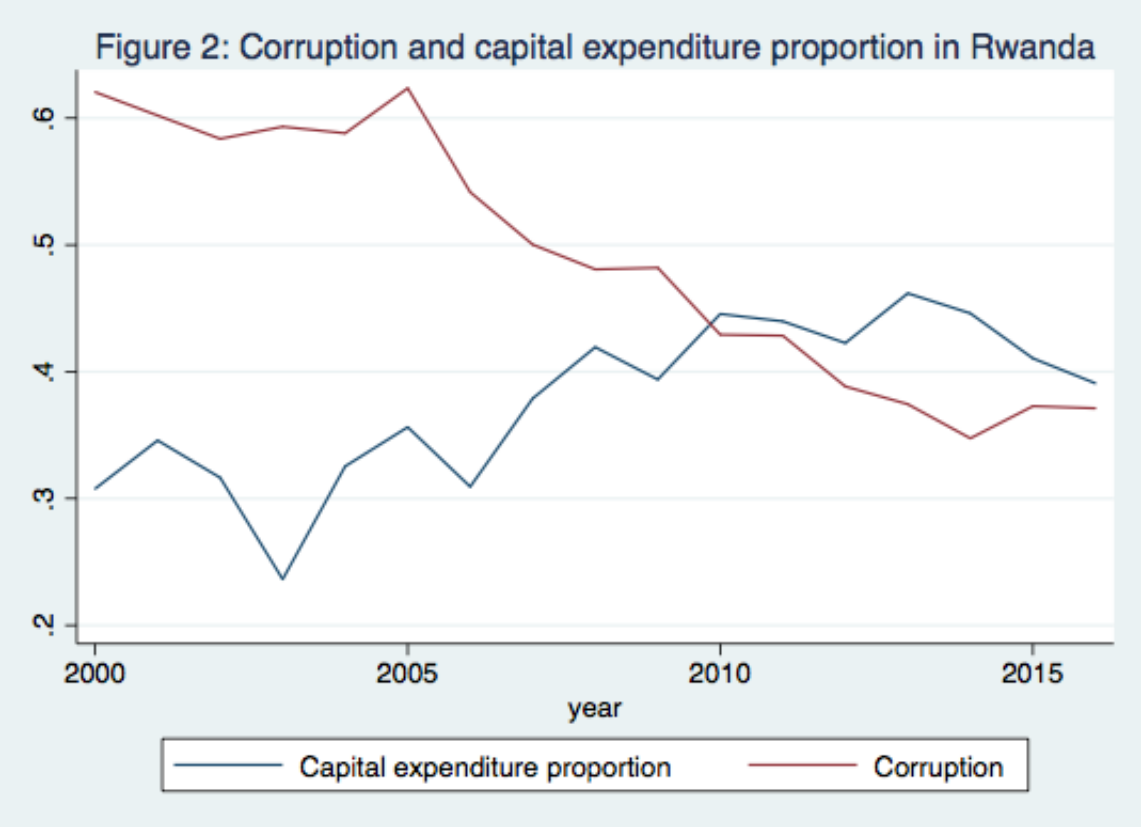
The statistics of the first stage allow validation of the explanatory power of the instrument. In addition, accountability should not affect the structure of public expenditures. An accountable government allocates and implements public resources in accordance with the social interest. Here, we use the voice and accountability index of the World Bank as a proxy of accountability to identify the causal effect of corruption on the capital expenditure proportion. It "reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media". This indicator measures the ability of citizens to hold leaders accountable for their actions. This empirical strategy leads to the results below.

4 Results

4.1 Preliminary evidence

Figures 2 provides a visual analysis of the relationship between corruption and the proportion of capital expenditure. This figure displays the evolution of corruption and the share of capital expenditure in Rwanda. Two reasons justify the choice of this country: Rwanda is ranked as a leader in institutional and policy quality according to the World Bank's Country Policy and Institutional Assessment (CPIA) in Sub-Saharan Africa in 2019. It scored 4 out of 6. Rwanda also is the top African country that has seen a phenomenal reduction in its level of corruption since 1996. Today, this country ranks among the five (5) least corrupt countries in Africa, whereas in 1996 it was among the most corrupt.

The graph shows a decline in corruption from 0.62 in 2000 to 0.37 in 2016. In the same period, the country experienced an increase in the proportion of capital expenditure from 31% to 39% of total expenditure. The evidence seems to show a relationship between corruption and the share of capital expenditure.



4.2 Basic results

We start with the estimation of equation (1) by fixed effects to see if corruption influences the proportion of capital expenditure. The Hausman test indicates a preference for fixed effects. Table 2 reports the results of estimates of the distorting effect of corruption on the proportion of capital expenditure. In model 1, corruption is the single explanatory variable. In model 2 we add tax effort, GDP per capita in purchasing power parity(log), inflation rate, share of the population aged 0 to 14, proportion of the urban population, net official development assistance (log) and the share of the population with access to electricity. Model 3 adds natural resource rents and Model 4 adds democracy.

The results show that corruption is negatively and significantly correlated to the share of capital expenditure at the 1% error threshold in all models.

Even if fixed effects have the advantage of purging country-specific and time-invariant effects, other potential limitations associated with empirical studies may be of concern for this study. They include alternative scenarios, and methodology.

Table 2: Corruption and capital expenditure proportion: fixed effects estimation

Dependent variable: capital expenditure (to total)				
	(1)	(2)	(3)	(4)
Estimator	FE	FE	FE	FE
Corruption	-0.417***	-0.307***	-0.292***	-0.276***
	(0.0713)	(0.0748)	(0.0770)	(0.0789)
Tax revenue to GDP (%)		0.00341***	0.00373***	0.00383***
		(0.000778)	(0.000839)	(0.000848)
GDP per capita PPP(log)		0.0261	-0.00997	-0.0164
		(0.0386)	(0.0379)	(0.0369)
Inflation rate (%)		-0.000320***	-0.000381***	-0.000314***
		(9.36e-05)	(8.94e-05)	(8.39e-05)
Population 0 to 14 (%)		0.00666*	0.00689**	0.00746**
		(0.00340)	(0.00333)	(0.00340)
Urban population share (%)		0.00464**	0.00177	0.00238
		(0.00191)	(0.00179)	(0.00177)
Net ODA per capita (log)		0.00408	0.00655	0.00456
		(0.00656)	(0.00621)	(0.00645)
Access to electricity(%)		0.00191**	0.00239***	0.00254***
		(0.000898)	(0.000859)	(0.000872)
Resource rents to GDP(%)			-0.00166**	-0.00170**
			(0.000711)	(0.000713)
democracy				0.000526***
				(0.000197)
Constant	0.527***	-0.326	0.0353	0.0319
	(0.0457)	(0.391)	(0.378)	(0.376)
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	816	795	789	756
F-stat	4.55	4.97	5.29	5.13
	0.0000	0.0000	0.0000	0.0000
Adjusted R-squared	0.690	0.719	0.715	0.708
Number of country	48	47	47	45

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.3 Alternative scenarios

4.3.1 Democracy regimes

We use an alternative measure of democracy to check whether the effect of corruption on the share of capital expenditure is resistant to different democratic regimes. Thus, we convert the polity scores variable of Political Risk Services (PRS) into regime categories in a suggested three-part categorization of "autocracies" (-10 to -6), "anocracies" (-5 to +5 and three special values: -66, -77 and -88), and "democracies" (+6 to +10). The three dummies are then multiplied by the corruption variable to account for the interaction effect.

The results are shown in Table 3. The second model takes into account the three democratic regimes, namely autocracy, democracy with anocracy as the reference variable. The third model takes into account these democratic regimes by adding their interactions with corruption. The negative effect of corruption on the proportion of capital expenditure remains significant, indicating that an increase in corruption reduces the share of capital expenditure in total expenditure. As we can see, autocracy is negative but not significant. Its interaction with corruption is also insignificant. However, democracy is significantly

positive in model 2 but becomes significantly negative in model 3 when its interaction with corruption is taken into account. This result seems to indicate that democracy negatively affects the proportion of capital expenditure, but, in the presence of corruption, it becomes favorable to capital expenditure compared to an anocratic regime.

Table 3: Corruption and capital expenditure proportion: fixed effects estimation with democracy regime categories

Dependent variable: capital expenditure (to total)			
	(1)	(2)	(3)
Estimator	FE	FE	FE
Corruption	-0.292***	-0.263***	-0.417***
	(0.0770)	(0.0812)	(0.0857)
Autocracies		-0.000609	-0.0227
		(0.0153)	(0.116)
Autocracies*corruption			0.0250
			(0.189)
Democracies		0.0278**	-0.242***
		(0.0125)	(0.0633)
Democracies*corruption			0.421***
			(0.0993)
Tax revenue to GDP (%)	0.00373***	0.00413***	0.00421***
	(0.000839)	(0.000883)	(0.000900)
GDP per capita PPP(log)	-0.00997	-0.00987	-0.000805
	(0.0379)	(0.0386)	(0.0386)
Inflation rate (%)	-0.000381***	-0.000370***	-0.000356***
	(8.94e-05)	(8.45e-05)	(8.40e-05)
Population 0 to 14 (%)	0.00689**	0.00752**	0.00770**
	(0.00333)	(0.00343)	(0.00342)
Urban population share (%)	0.00177	0.00315*	0.00376**
	(0.00179)	(0.00181)	(0.00181)
Net ODA per capita(log)	0.00655	0.00452	0.00414
	(0.00621)	(0.00643)	(0.00658)
Access to electricity(%)	0.00239***	0.00260***	0.00282***
	(0.000859)	(0.000875)	(0.000872)
Resource rents to GDP(%)	-0.00166**	-0.00179**	-0.00170**
	(0.000711)	(0.000730)	(0.000739)
Constant	0.0353	-0.0694	-0.0672
	(0.378)	(0.390)	(0.388)
Country FE	YES	YES	YES
Time FE	YES	YES	YES
Observations	789	756	756
F-stat	5.29	4.93	5.39
P-value	0.0000	0.0000	0.0000
Adjusted R-squared	0.715	0.706	0.711
Number of country	47	45	45
Robust standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

4.3.2 Natural resources

We now consider total natural resource rents, oil rents, mineral rents and forest rents and their interactions with corruption. The objective is to see whether the negative impact of corruption on the proportion of capital expenditure does not come from natural resources.

Table 4 presents the results of the estimation taking into account natural resources and its components. The negative impact of corruption on the proportion of capital expenditure remains significant in all models. This shows that the negative effect of corruption is not due to natural resources. Natural resource rents have a significant negative effect, indicating that natural resources reduce the share of capital expenditure. The adverse effect of natural resource rents on the proportion of capital expenditure is consistent with the findings of Bhattacharyya and Collier (2013). However, its interaction with corruption is significantly positive. A decomposition of the natural resource rents shows that it is the mineral resource rents that mainly derive this negative effect. Indeed,

the mineral rents are negative and significant, whereas the oil rents and forest rents, although negative, are never significant. This result indicates that, in addition to the adverse effect of corruption, natural resource rents negatively affect the proportion of capital expenditure in resource-rich countries, especially in countries rich in mineral rents.

Table 4: Corruption and capital expenditure proportion: fixed effects with resource rents and its components

Dependent variable: capital expenditure (to total)						
	(1)	(2)	(3)	(4)	(5)	(6)
Estimator	FE	FE	FE	FE	FE	FE
Corruption	-0.276***	-0.490***	-0.334**	-0.361***	-0.299***	-0.470***
	(0.0789)	(0.0867)	(0.131)	(0.0785)	(0.101)	(0.100)
Tax revenue to GDP (%)	0.00383***	0.00326***	0.00344**	0.00354***	0.00358***	0.00361***
	(0.000848)	(0.000853)	(0.00139)	(0.000801)	(0.000790)	(0.000916)
GDP per capita PPP(log)	-0.0164	-0.00869	-0.0138	0.0277	0.000917	-0.0146
	(0.0369)	(0.0361)	(0.0851)	(0.0369)	(0.0424)	(0.0420)
Inflation rate (%)	-0.000314***	-0.000286**	-0.000302**	-0.000185**	-0.000293***	-0.000238**
	(8.39e-05)	(0.000113)	(0.000130)	(8.90e-05)	(9.16e-05)	(0.000112)
Population 0 to 14 (%)	0.00746**	0.00773**	0.00617	0.00779**	0.00697*	0.00664*
	(0.00340)	(0.00345)	(0.00759)	(0.00354)	(0.00361)	(0.00345)
Urban population share (%)	0.00238	0.00395**	0.00236	0.00617***	0.00558***	0.00358*
	(0.00177)	(0.00179)	(0.00345)	(0.00186)	(0.00190)	(0.00186)
Net ODA per capita (log)	0.00456	0.00386	0.00369	0.00359	0.00232	0.00476
	(0.00645)	(0.00626)	(0.0113)	(0.00688)	(0.00685)	(0.00644)
Access to electricity(%)	0.00254***	0.00238***	0.00242	0.00209**	0.00198**	0.00237***
	(0.000872)	(0.000863)	(0.00190)	(0.000898)	(0.000922)	(0.000854)
Resource rents to GDP (%)	-0.00170**	-0.0180***				
	(0.000713)	(0.00452)				
Resource rents to GDP*corruption		0.0234***				
		(0.00654)				
oil rents to GDP(%)			-0.0128			-0.0125
			(0.0118)			(0.00807)
oil rents to GDP*corruption			0.0156			0.0152
			(0.0147)			(0.0108)
Mineral rents to GDP(%)				-0.0338***		-0.0331***
				(0.00824)		(0.00806)
Mineral rents to GDP*corruption				0.0479***		0.0477***
				(0.0124)		(0.0121)
Forest rents to GDP(%)					-0.00244	-0.0121
					(0.0118)	(0.0111)
Forest rents to GDP*corruption					-0.000352	0.0142
					(0.0170)	(0.0160)
Democracy	0.000526***	0.000428**	0.000504**	0.000415**	0.000466**	0.000353*
	(0.000197)	(0.000200)	(0.000216)	(0.000196)	(0.000193)	(0.000206)
Constant	0.0319	0.0534	0.105	-0.409	-0.163	0.140
	(0.376)	(0.368)	(0.854)	(0.387)	(0.427)	(0.412)
Country FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Observations	756	756	756	762	762	756
F-stat	5.13	5.51	7.92	5.67	4.94	4.92
P-Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Adjusted R-squared	0.708	0.715	0.706	0.724	0.713	0.717
Number of country	45	45	45	45	45	45
Robust standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

4.3.3 Alternative dependent variable measure

Total expenditures here include capital expenditure, current expenditure and net lending. Although net lending accounts for less than 1% of total expenditures on average over the period, its variability could lead to an underestimation or overestimation of the trade-off effect between capital and current expenditures. To account for this potential problem, we relate capital expenditure directly to current expenditure. The estimation results with the proportion of capital expenditure in current expenditure as the dependent variable are reported in Table 5. Corruption significantly reduces the proportion of capital expenditure in current expenditure. The coefficients are even slightly larger than those in Table 2.

Table 5: Corruption and capital expenditure proportion: fixed effects estimation with alternative dependent variable

Dependent variable: capital expenditure (to current expenditure)				
	(1)	(2)	(3)	(4)
Estimator	FE	FE	FE	FE
Corruption	-1.128***	-0.468**	-0.535**	-0.440*
	(0.233)	(0.236)	(0.229)	(0.234)
Tax revenue to GDP (%)		0.0173***	0.0139***	0.0141***
		(0.00407)	(0.00364)	(0.00368)
GDP per capita PPP(log)		0.662***	0.270	0.270
		(0.256)	(0.202)	(0.204)
Inflation rate (%)		-2.09e-05	-0.000422**	-0.000297
		(0.000235)	(0.000214)	(0.000207)
Population 0 to 14 (%)		0.0213*	0.0233*	0.0253**
		(0.0126)	(0.0120)	(0.0126)
Urban population share (%)		0.0274**	-0.0127*	-0.0108*
		(0.0140)	(0.00677)	(0.00655)
Net ODA per capita(log)		0.0219	0.0435	0.0451
		(0.0315)	(0.0308)	(0.0330)
Access to electricity(%)		0.00504	0.0114***	0.0119***
		(0.00404)	(0.00343)	(0.00353)
Resources rents to GDP(%)			-0.00357	-0.00378
			(0.00357)	(0.00358)
Democracy				0.000768**
				(0.000390)
Constant	1.131***	-6.886***	-2.531	-2.752
	(0.157)	(2.612)	(1.908)	(1.952)
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	816	795	789	756
F-stat	3.05	4.11	3.56	3.42
P-value	0.0000	0.0000	0.0000	0.0000
Adjusted R-squared	0.669	0.711	0.763	0.764
Number of country	48	47	47	45
Robust standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

4.3.4 Alternative measure of corruption

The corruption index is subject to measurement error. For an additional robustness check, we use an alternative measure of corruption from the V-Dem (Varieties of Democracy) database (Coppedge et al., 2019). V-Dem has three corruption indicators: Political corruption index, Executive corruption index and Public sector corruption index. Public sector corruption is more suitable for our hypothesis. This indicator is constructed from survey data based on the question "To what extent do public sector employees grant favors in exchange for bribes, kickbacks, or other material inducements, and how often do they steal, embezzle, or misappropriate public funds or other state resources for personal or family use? It ranges from less corrupt (0) to more corrupt (1). The results are presented in Table 6. With this alternative measure of corruption from V-Dem, the result remains robust and confirms the main conclusion.

4.3.5 Five-year averages

Given the slow evolution of the quality of institutions, we make five-year averages. The results of the estimation by fixed effects are recorded in table 7. These results are consistent with our baseline results. Corruption is associated with a significant decrease in the proportion of capital expenditure.

Table 6: Corruption and capital expenditure proportion: fixed effects estimation with alternative measures of corruption (V-dem data) and the two dependent variables

Dependent variable: capital expenditure (to total(1) and to current expenditure(2))		
	(1)	(2)
Estimator	FE	FE
Public sector corruption	-0.0808**	-0.209*
	(0.0411)	(0.118)
Tax revenue to GDP (%)	0.00392***	0.0142***
	(0.000838)	(0.00359)
GDP per capita PPP(log)	0.00684	0.306
	(0.0350)	(0.200)
Inflation rate (%)	-0.000351***	-0.000364*
	(8.72e-05)	(0.000218)
Population 0 to 14 (%)	0.00753**	0.0251**
	(0.00334)	(0.0123)
Urban population share (%)	0.00167	-0.0121*
	(0.00178)	(0.00649)
Net ODA per capita(log)	0.00524	0.0448
	(0.00642)	(0.0333)
Access to electricity(%)	0.00269***	0.0121***
	(0.000859)	(0.00338)
Resource rents to GDP(%)	-0.00199***	-0.00428
	(0.000684)	(0.00348)
Democracy	0.000627***	0.00100**
	(0.000198)	(0.000419)
Constant	-0.243	-3.098*
	(0.341)	(1.842)
Country FE	YES	YES
Time FE	YES	YES
Observations	756	756
F-stat	4.22	2.69
P-value	0.0000	0.0000
Adjusted R-squared	0.705	0.765
Number of country	45	45
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

4.4 Two-stage least squares estimation

To confirm that this effect is causal, we use the two-stage least squares method. Accountability (voice and accountability) is used as an instrument. The results of the first stage show that the instrument is negatively and significantly correlated with corruption at conventional error thresholds. The Fisher test (F stat) is significant at the 1% threshold and its statistics are well above 10 as suggested by Stock, Wright, and Yogo (2002) to validate the explanatory power of the instrument. The Kleibergen-Paap LM statistic, Sanderson-Windmeijer tests and Cragg-Donald Wald F statistic reject the null hypothesis (Ho) of underidentification and poor identification of the estimated equation. Thus, our instrument has significant explanatory power for corruption. Its uniqueness does not allow us to obtain Hansen's statistics (Hansen J statistic) for the overidentification test.

The results show coefficients that are always significant and higher with the instrumental variable method (Table 8) than the fixed effects method (Table 2). Indeed, a high prevalence of corruption reduces the proportion of capital expenditure. An increase in corruption by one standard deviation is associated with a decrease in the proportion of capital expenditure from 29.3% to 16.2%, i.e. a decrease of 13 percentage points. This result is in line with our prediction that the prevalence of corruption could lead to a reduction in the proportion of capital expenditure due to its less discretionary allocation and the higher risk of corrupt practice in this category of expenditure.

The explanatory variables generally have the expected signs (Table 8), except access to electricity. The existence of significant infrastructure (measured by the proportion of the population with access to electricity), the tax effort, the proportion of the popula-

Table 7: Corruption and capital expenditure proportion: fixed effects estimation with five-year averages

Dependent variable: capital expenditure (to total)				
	(1)	(2)	(3)	(4)
Estimator	FE	FE	FE	FE
Corruption	-0.525***	-0.429***	-0.394**	-0.361*
	(0.148)	(0.164)	(0.169)	(0.186)
Tax revenue to GDP (%)		0.00357**	0.00517***	0.00531***
		(0.00149)	(0.00195)	(0.00199)
GDP per capita PPP(log)		-0.0448	-0.0699	-0.0606
		(0.0777)	(0.0755)	(0.0763)
Inflation rate (%)		-0.000690***	-0.000818***	-0.000507
		(0.000242)	(0.000242)	(0.000329)
Population 0 to 14 (%)		0.00827	0.00831	0.0104
		(0.00700)	(0.00657)	(0.00687)
Urban population share (%)		0.00308	0.00105	0.00208
		(0.00356)	(0.00304)	(0.00329)
Net ODA per capita(log)		0.00349	0.0118	0.00951
		(0.0159)	(0.0153)	(0.0171)
Access to electricity(%)		0.00372**	0.00411**	0.00434***
		(0.00174)	(0.00161)	(0.00165)
Resources rents to GDP(%)			-0.00252*	-0.00258*
			(0.00148)	(0.00148)
democracy				0.000798*
				(0.000434)
Constant	0.598***	0.230	0.439	0.223
	(0.0900)	(0.804)	(0.781)	(0.820)
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	192	189	188	180
F-stat	4.37	5.05	5.09	4.71
	0.0023	0.0000	0.0000	0.0000
Adjusted R-squared	0.697	0.747	0.754	0.739
Number of country	48	47	47	45

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

tion aged between 0 and 14 and the share of the urban population have a positive and significant effect on the proportion of capital expenditure. However, we expected a large infrastructure network to have a negative effect on the proportion of capital expenditure.

A high level of development (measured by GDP per capita) and inflation (measuring unfavorable economic conditions) significantly reduce the proportion of expenditure dedicated to public investment. Natural resources, although having a negative sign, are not significant now. The Official Development Assistance per capita values are not also significant.

4.5 Further robustness check

To reinforce the results of the double least squares and to test the robustness of the causality, we use the interactive-fixed effects method proposed by Bai (2009). For Bai (2009), the interactive effects represent unobservable common shocks with heterogeneous cross-sectional effects. This method has the advantage of taking into account unobservables and their potential correlation with regressors, which could be a source of endogeneity. For Moon and Weidner (2015), the interactive fixed effect allows the heterogeneity of the data to be captured more flexibly by allowing the common temporal shocks to affect the cross-sectional units with individual sensitivity. This estimator is also valid in the presence of auto-correlation and heteroskedasticity of unknown forms in both dimensions. This method was used among others by Kim and Oka (2014) to evaluate the impact of divorce law reform on the divorce rate in the United States, and by Gobillon and Magnac

Table 8: Corruption and capital expenditure proportion: Instrumental Variables Estimation

Dependent variable: capital expenditure (to total)				
	(1)	(2)	(3)	(4)
Estimator	IV	IV	IV	IV
Corruption	-0.653**	-0.988***	-1.106***	-0.938***
	(0.279)	(0.285)	(0.288)	(0.268)
Tax revenue to GDP (%)		0.00319***	0.00308***	0.00342***
		(0.000807)	(0.000908)	(0.000888)
GDP per capita PPP(log)		-0.0310	-0.0847*	-0.0750*
		(0.0457)	(0.0454)	(0.0439)
Inflation rate (%)		-0.000251***	-0.000292***	-0.000250***
		(9.27e-05)	(9.48e-05)	(8.88e-05)
Population 0 to 14 (%)		0.00633*	0.00630*	0.00656*
		(0.00357)	(0.00355)	(0.00355)
Urban population share (%)		0.00605***	0.00312*	0.00372**
		(0.00200)	(0.00189)	(0.00187)
Net ODA per capita(log)		8.06e-05	0.00109	-0.000572
		(0.00708)	(0.00698)	(0.00706)
Access to electricity(%)		0.00151*	0.00195**	0.00204**
		(0.000910)	(0.000885)	(0.000875)
Resource rents to GDP(%)			-0.000958	-0.00113
			(0.000787)	(0.000773)
democracy				0.000462**
				(0.000197)
Country FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	816	794	788	755
F-stat	67.47	63.40	63.02	69.08
P-value	0.0000	0.0000	0.0000	0.0000
Sanderson-Windmeijer (sw)	69.00	65.51	65.22	71.70
Sw p-value	0.0000	0.0000	0.0000	0.0000
Kleibergen-Paap LM stat	65.38	61.11	60.74	64.43
P-value	0.0000	0.0000	0.0000	0.0000
Cragg-Donald Wald F statistic	81.47	74.42	74.68	73.71
Number of country	48	47	47	45
Robust standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

(2016) for regional policy evaluation in France. Table 9 presents the results of the estimation by the interactive fixed effects. The impact of corruption is negative and significant. It confirms the causality of the relationship between corruption and the proportion of capital expenditure and its robustness.

Table 9: Corruption and capital expenditure proportion: interactive fixed effects estimation

Dependent variable: capital expenditure (to total)				
	(1)	(2)	(3)	(4)
Estimator	IFE	IFE	IFE	IFE
Corruption (WGI)	-0.388***	-0.366***	-0.402***	-0.398***
	(0.105)	(0.101)	(0.0938)	(0.0944)
Tax revenue to GDP (%)		0.00336***	0.00240***	0.00298***
		(0.000775)	(0.000761)	(0.000759)
GDP per capita PPP(log)		0.247***	0.169***	0.165***
		(0.0510)	(0.0515)	(0.0527)
Inflation rate		-0.000261**	-0.000367***	-0.000346***
		(0.000116)	(0.000102)	(0.000105)
Population 0 to 14 (%)		0.00478	-0.00471	-0.00871
		(0.0102)	(0.00581)	(0.00648)
Urban population share (%)		-0.0239***	-0.0165***	-0.0138**
		(0.00843)	(0.00636)	(0.00629)
Net ODA par capita(log)		-0.00189	-0.00587	-0.0114**
		(0.00552)	(0.00544)	(0.00554)
Access to electricity(%)		-0.00190*	-0.00265**	-0.00258**
		(0.00103)	(0.00102)	(0.00101)
Resource rents to GDP(%)			-0.00115**	-0.00142**
			(0.000580)	(0.000580)
democracy				-9.60e-05
				(0.000176)
Constant	0.531***	-0.660	0.153	0.240
	(0.0648)	(0.641)	(0.523)	(0.544)
Observations	816	794	788	755
Number of factor	2	2	2	2
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

5 Conclusion

In this study, we carried out an empirical analysis of the distorting impact of corruption on the composition of public spending by economic function in Africa. Our results show that corruption distorts the structure of public expenditure to the detriment of capital spending.

Using panel data with fixed effects and two-stage least square methods, it is established that corruption significantly reduces the proportion of capital expenditure as a percentage of total and current expenditures. An increase in corruption by one standard deviation is associated with a decrease in the proportion of capital expenditure from 29.3% to 16.2%, i.e. a decrease of 13 percentage points. The negative impact of corruption on the proportion of capital expenditure is robust to distinguishing between different democratic regimes, using an alternative dependent variable, using the public sector corruption variable from the V-Dem database, computing five-year average data and using interactive fixed effects estimations. This misallocation of public resources is a source of inefficiency in African countries. These results, combined with those of Barro (1991) and Bose, Haque, and Osborn (2007) who argue that only capital spending is conducive to economic growth, partly explain the tragedy of economic development in Africa. Our results therefore highlight one of the channels through which corruption affects economic performance, particularly in Africa.

According to our findings, strong anti-corruption measures should be encouraged in Africa because they offer prospects for increasing the proportion of public investment, which is conducive to public service access and long-term economic development. The results also recommend that greater attention be paid to the proportion of capital expenditure in public development policies, particularly in resource-rich countries.

Controlling corruption could be a key to boosting economic performance in Africa.

Studies that highlight the determinants of corruption, specifically in Africa, would thus serve to better characterize the phenomenon and examine more promising anti-corruption prospects.

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6 Appendices

Table 10: Sample composition

African countries
Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Cote d Ivoire, Democratic Republic of the Congo, Djibouti, Egypt, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzani, Togo, Tunisia, Uganda, Zambia