

# Corruption, Military Spending and Growth

d'Agostino G.\*, Dunne J. P.\*\* , Pieroni L.\*\*\*

\* University of Rome III (Italy), and University of the West of England (UK)

\*\* University of the West of England (UK), and University of Cape Town (RSA)

\*\*\* University of Perugia (Italy), and University of the West of England (UK)

## Abstract

This paper considers the effect of corruption and military spending on economic growth, analyzing both the direct impact of public spending and the effect of allocating resources between categories of public spending within the framework of an endogenous growth model. The model exhibits non-linearities as a result of the links between the components of public spending, corruption and economic growth. The main findings of the empirical analysis confirm the expectation that corruption and military burden lower the growth rate of GDP per capita. They also suggest that when the effect of the complementarity between military spending and corruption is omitted, as in most studies, the impact of military burden on economic performance is underestimated.

Keywords : corruption, military spending, development economics

JEL Classification : O57, H5, D73

# 1 Introduction

Allegations of corruption in the military sector are neither infrequent nor unexpected. It is often argued that the limited competition in the defence sector leads to a relatively high level of informal contracts and to rent-seeking activities, providing fertile ground for the growth of corrupt practices (Transparency International, 2002). This can lead to an increase in the cost of military activities and their burden on the economies, directly through rent seeking in the military sector and indirectly by crowding out productive investment in the private sector.

This paper uses the theoretical framework of the endogenous growth model originally developed by Barro (1990) and introduces as key explanatory variables the complementary effects that arise between private and public sectors and the detrimental effects of corruption. In this model government expenditure on the military sector and public investment are defined as potentially productive inputs, with differing productivity and corruption impacts on the long run economic growth. The model also incorporates any inefficiencies in corruption linked services provided by the public sector (red tape and administrative corruption), although they do not affect long run growth.

This research adds to a number of empirical papers that test if the increase in corruption enhance the level of military spending (and vice-versa), implying that they are complements in constraining economic growth (Mauro, 1995, 1998; Aizenman and Glick, 2003). It is particularly close in spirit to Tanzi (1998) Gupta *et al.* (2001) who argued that productive public investments are scaled down in countries with widespread corruption, in favour of less verifiable/transparent government expenditure, such as military spending. It contributes in this literature in two ways using a large panel of African countries. First, testing if the magnitude of corruption is associated with the size of expenditure on the military sector (as well as government spending on investment) and how this externality leads to reduced economic growth. Second. estimating elasticities from empirical model and undertaking sensitivity analyses. In particular, the robustness of the results are investigated by considering how

high and low shares of military expenditure might influence the correlation of corruption and the growth rate.

The remainder of the paper is organized as follows. Section 2 presents the theoretical model and describe the empirical hypothesis derived by a comparative static analysis. Section 3 presents the data and methods used, with Section 4 presenting the empirical results. Finally Section 5 provides some conclusions.

## 2 Theoretical model

In our model a representative household produces a composite commodity, which can be consumed, accumulated as capital or paid as income tax and a government provides three different public goods by spending in the defence sector, public investments and current government consumption. As in Shieh *et al.* (2002), it is assumed that the components of public spending may have complementary effects to the private productive sector and that current government consumption can also directly affect the utility function of the representative household. To complete the theoretical framework corruption<sup>1</sup> is included, which can complement government spending in affecting the growth rate.

### 2.1 Model set-up

Consider a representative household maximizing a utility function, choosing the optimal amount of private consumption, conditional on the services provided by the government. The agent maximize the discounted sum of future instantaneous utilities,

$$(1) \quad \text{MAX} \int_0^{\infty} U(c, c_p) e^{-\rho t} dt$$

where  $c$  and  $c_p$  are the arguments related to private and current government consumption,

---

<sup>1</sup>Corruption is generally defined as the abuse of public office for private gain. Nye (1967) defines corruption as behaviour which deviates from the normal duties of a public role because of private pecuniary or status gain, or violates rules against the exercise of private-regarding influence.

respectively, and  $\rho$  is the subjective discount rate. To keep the specification as simple as possible, we model an instantaneous utility function in logarithmic form:

$$(2) \quad U(c, c_p) = \ln c + \eta \ln c_p$$

where  $\eta$  measures the amount of services that are effectively provided by the government, which may be interpreted as the pervasiveness of red tape in the economic system<sup>2</sup>, and in countries with weak institutions this is strongly related to administrative corruption<sup>3</sup>. When  $\eta = 1$ , the entire amount of current government consumption is used to provide services to household, while for  $\eta < 1$  there are inefficiencies.

The production function is modelled as an interaction between private capital  $k$  and total public spending  $G$ , which is distributed across two productive public expenditure categories, that we identify as military spending  $M$  and public investment  $I$ , and current government consumption expenditure  $c_p$ . The production function in aggregate embodies constant returns to scale technology, with diminishing returns to each factor:

$$(3) \quad y = Ak^{1-\alpha-\beta-\delta} M^\alpha I^\beta c_p^\delta$$

The household budget constraint is given by:

$$(4) \quad \dot{k} = (1 - \tau)Ak^{1-\alpha-\beta-\delta} M^\alpha I^\beta c_p^\delta - c$$

where  $\tau$  is the flat-rate of income tax.

We assume that the government uses the total amount of tax collected ( $\tau y$ ) to finance total public spending ( $G$ ), allocating it among the productive public sectors ( $M$ ,  $I$ ) and current government consumption ( $c_p$ ). The government then follows specific rules described

---

<sup>2</sup>We define red tape as "unnecessary" or "excessive" official routines, rules, or procedures resulting in delays: see Guriev (2004).

<sup>3</sup>In particular, administrative corruption worsens the effectiveness of the services delivered by the public sector and reduces the contribute of current government consumption to household utility.

by:

$$(5) \quad M = h_1 g_{mil} G$$

$$(6) \quad I = h_2 g_{inv} G$$

$$(7) \quad c_p = h_3 g_{cons} G$$

where  $g_{mil}$ ,  $g_{inv}$  and  $g_{cons}$  denote the fraction of public resources allocated to the different components. It is also assumed that corruption affects these expenditures, with  $h_1$ ,  $h_2$  and  $h_3$  identifying the impact on military spending, public investment and current government consumption respectively.

The representative household choses the optimal amount of private consumption so as to maximize (2) subject to (4), (5), (6), (7) and given an initial level of private capital  $k$ . The steady state growth equation is given by:

$$(8) \quad \gamma = \frac{\dot{c}}{c} = (1 - \alpha - \beta - \delta)(1 - \tau)A (h_1 g_{mil})^\alpha (h_2 g_{inv})^\beta (h_3 g_{cons})^\delta \left(\frac{G}{k}\right)^{\alpha+\beta+\delta} - \rho$$

where  $\gamma$  is the growth rate of consumption. Following Devarajan *et al.* (1996) this depends on the allocation of spending across categories of government expenditure and on the amount of general corruption affecting the performance indicators<sup>4</sup> It is worth noting that assuming the degree of corruption can be modelled as a tax allows the degree of exposure to corruption to vary across categories of productive public expenditures, see Mariani (2007); Acemoglu and Verdier (1998) and Delavallade (2007).

In the steady-state, the tax rate  $\tau$  (and hence  $G/k$ ) is constant and we can rearrange the previous formulation as:

$$(9) \quad \gamma = j (h_1 g_{mil})^{\frac{\alpha}{1-\alpha-\beta-\delta}} (h_2 g_{inv})^{\frac{\beta}{1-\alpha-\beta-\delta}} (h_3 g_{cons})^{\frac{\delta}{1-\alpha-\beta-\delta}} - \rho$$

---

<sup>4</sup>.

with  $j = (1 - \alpha - \beta - \delta)(1 - \tau)A^{\frac{1}{1-\alpha-\beta-\delta}}\tau^{\frac{\alpha+\beta+\delta}{1-\alpha-\beta-\delta}}$ .

This formulation has the advantage that the growth rate is specified only as a function of the government spending categories and the relative levels of corruption. It is important to stress that only general corruption enters directly into the growth equation and corruption only affects the household utility function indirectly. This result is linked to the choice of an isoelastic functional form for the utility function.

## 2.2 Comparative statics

Consider  $g_i$  one component of the government expenditure,  $g_i$ . Without loss of generality, the partial derivative of  $\gamma$  with respect to  $g_i$  is described as:

$$(10) \quad \begin{aligned} \frac{\partial \gamma}{\partial g_i} &\geq 0 && \text{when } g_i \leq g_i^* \\ \frac{\partial \gamma}{\partial g_i} &< 0 && \text{otherwise} \end{aligned}$$

where  $g_i^*$  is the optimal share of resources of the sector  $i$ , which depends on the relation between its productivity and that of other public spending categories. As argued in Gupta et al. (2001), the decisions that determine the allocation of resources to each sector are not exclusively motivated by need, but also by the possibility, for bureaucrats and/or policy-makers to make private gains. For this reason, it seems reasonable to assume that the degree of exposure to corruption is not identical across categories of government spending. Furthermore, because we analyze the effects on economic growth, leaving the analysis of the impact of corruption on welfare for future work, we can assume that the impact of corruption on current government consumption is negligible, i.e.,  $h_3 \cong 1$ .

Making the general assumption that corruption has a negative effect,  $\frac{\partial \gamma}{\partial h_i} < 0$  (where

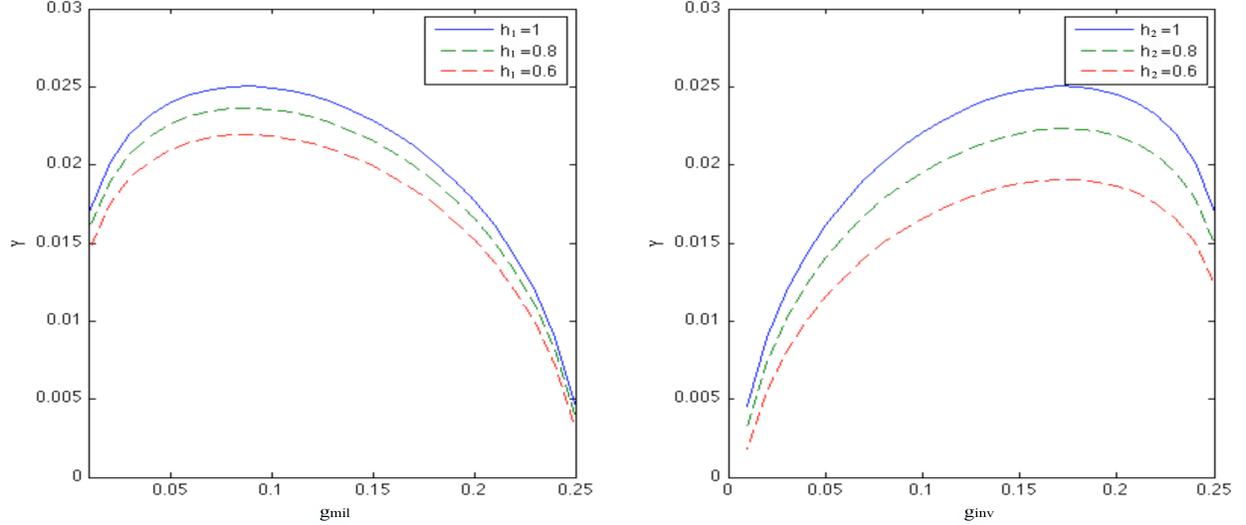
$i = 1, 2$ ) and  $0 < h_i \leq 1$ , gives<sup>5</sup>:

$$(11) \quad \begin{array}{l} \text{if } g_i \leq g_i^*, \quad \frac{\partial \gamma}{\partial g_i} \geq 0 \quad | \quad \frac{\partial \gamma}{\partial h_i} < 0 \implies \frac{\partial \gamma}{\partial g_i \partial h_i} \leq 0 \\ \text{if } g_i > g_i^*, \quad \frac{\partial \gamma}{\partial g_i} < 0 \quad | \quad \frac{\partial \gamma}{\partial h_i} < 0 \implies \frac{\partial \gamma}{\partial g_i \partial h_i} > 0 \end{array}$$

We note that when the share of government spending is higher (lower) than the optimal level, so that it has positive (negative) effects on growth rate, complementarities between the components of government spending and corruption arise. This is the main feature of the model that we consider in the empirical section.

To illustrate some properties of the model, figure 1 shows the simulated growth rates for changes in  $g_{mil}$  and  $g_{inv}$ , the shares of military spending and public investment, respectively, and the impact of changes in the levels of corruption  $h_1$  and  $h_2$ .

Figure 1: Government spending components, corruption and growth



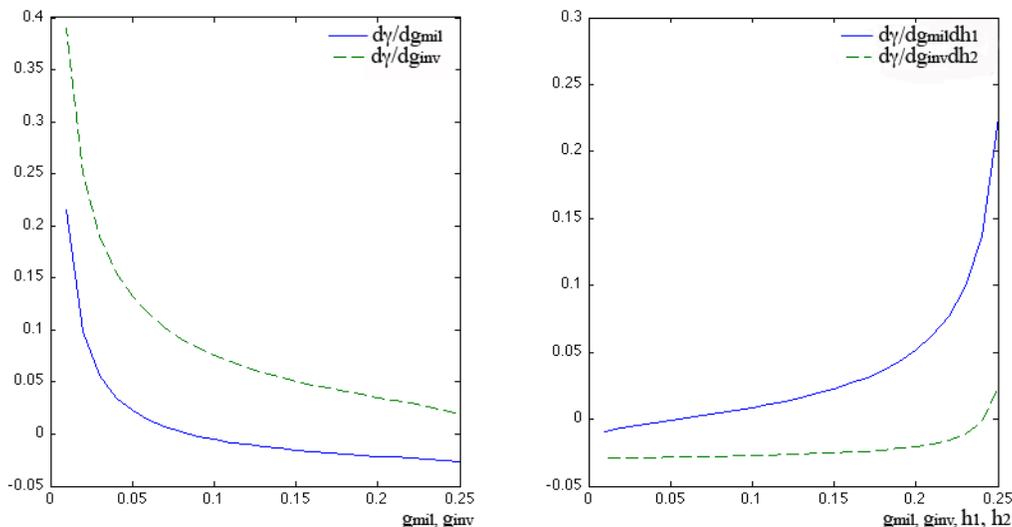
Notes:  $g_{mil}$  and  $g_{inv}$  are the shares of military and investment spending respectively and  $h_1$  and  $h_2$  describe the levels of corruption in the two categories of spending. The parameters used for the simulations are:  $\alpha = 0.1$ ,  $\beta = 0.2$ ,  $\eta = 0.6$ ,  $A = 0.7$ ,  $\rho = 0.02$

The solid line shows the baseline case in which corruption does not affect the growth rate (i.e.,  $h_1 = h_2 = 1$ ). The simulation functions (and the parameters used in the simulation)

<sup>5</sup>In this framework we do not allow for the possibility that corruption might promote economic growth by relaxing inefficient and rigid regulations imposed by governments (see for example, Dreher and Herzfeld (2005)).

are taken from Devarajan *et al.* (1996). The result above illustrates that the growth rate rises if the share of the government expenditure component is less than its optimal share  $g_i^*$ , with the form of the hump-shaped depending on the differences in productivity between the components.

Figure 2: Comparative static results



Notes: We describe with  $g_{mil}$  and  $g_{inv}$  the shares of resources to military and investment spending respectively, whereas  $h_1$  and  $h_2$  describe the levels of corruption in the two public sectors. The parameters used for the simulations are:  $\alpha = 0.1$ ,  $\beta = 0.2$ ,  $\eta = 0.6$ ,  $A = 0.7$ ,  $\rho = 0.02$

The second panel shows that public investment remains productive up to a relatively high share, unlike the share of current expenditure in the first panel. The broken lines show the model predictions for how corruption affects this relationship and, as expected, corruption in the more productive public investments has a greater negative impact on the growth rate. The simulations in Figure 2 confirm the expected signs derived from the comparative static analysis. The outcomes described in the first panel of Figure 2 show that the higher productivity of the second sector (by the imposition of  $\beta > \alpha$ ) shifts the optimal level of  $g_{inv}$  to the right. The derivative of  $\gamma$ , with respect to  $g_{inv}$  suggests increased shares of public resources have a positive impact up to a share of 20 percent. The second panel in Figure 2 plots the interaction effects of corruption and government spending on the growth rate and shows a positive (but decreasing) corruption complementarity that is more pronounced for  $g_{inv}$

## 3 Data and Methods

### 3.1 Data

Our empirical analysis uses a panel data set of 53 African countries for five years (from 2003 to 2007). The main source of our data is the African development indicator (ADI), available from the World Bank (WBI) and a complete list of countries is reported in Appendix 1.

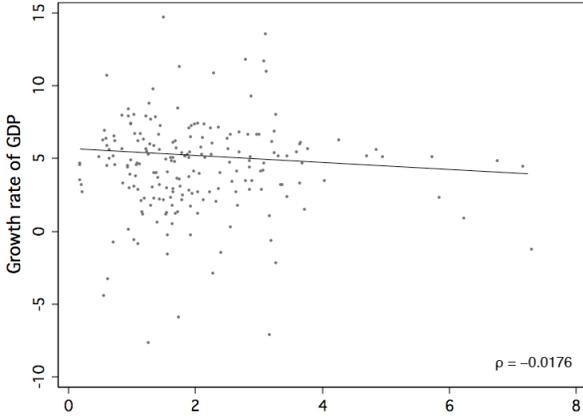
As reported above, the expenditures of the government sector is divided into two potentially productive components, military ( $g_{mil}$ ), public investment ( $g_{inv}$ ), with current government consumption ( $g_{cons}$ ) the residual category.<sup>6</sup> Private investment ( $p_{inv}$ ) is measured by the private fixed capital formation. All the variable are expressed as percentage of GDP and the dependent variable is the annual growth rate of per-capita GDP ( $\gamma$ ). We proxy corruption ( $corr$ ) by the "control of corruption index", an index derived by the survey that varies from 0 to 100. Although this index includes each component of corruption, it is mainly perceived as reflecting general corruption, not only because in African countries it is the magnitude of this general corruption that is most relevant, but also because administrative corruption shows much less variation over time. Two control variables that have received large attention in the economics literature, mainly in studies of private investment in African countries are then considered. The first variable measure the degree of economic openness ( $open$ ) and is obtained by the sum of imports and exports as a percentage of GDP, Ndikumana and Balioune-Lutz (2008). The second variable ( $stability$ ) measures the impact of violent acts on the life of citizens of a country, specifically with regard to the entrepreneurial sector.

In Figure 3, we plot bivariate relationships between the growth rate and the relevant

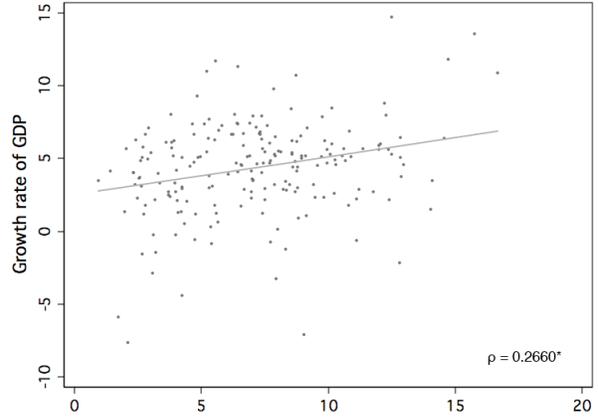
---

<sup>6</sup>That is, it is not directly collected in the survey but calculated as the difference between total government spending and public investment. Current government consumption derived in this way above does contain double counting of the components of consumption of the military sectors. We can reasonably assume that this bias does not have much influence the estimation results as it seems reasonable to suppose that current military spending affects the growth rate in a similar way to consumption in aggregate.

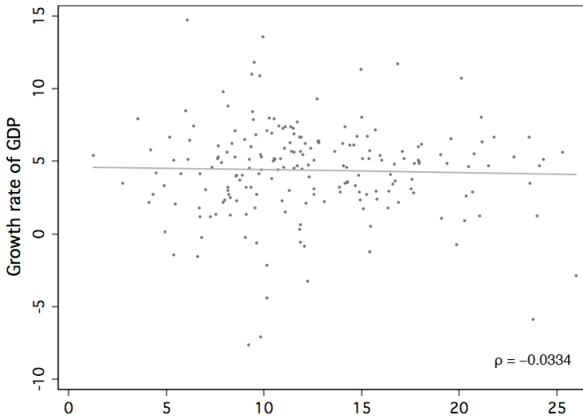
Figure 3: Government spending, corruption and economic growth



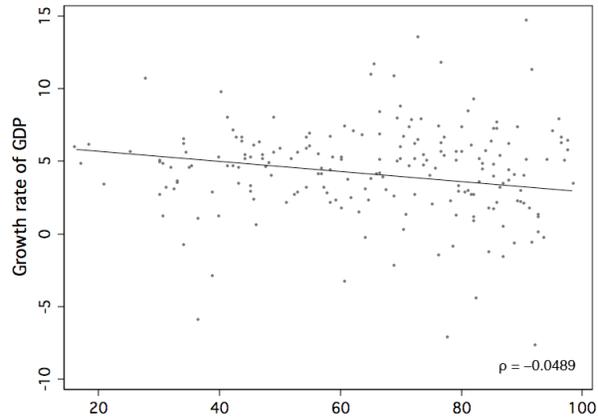
(a) Military spending



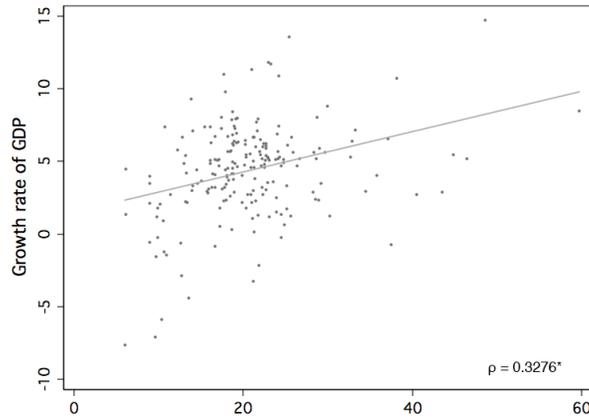
(b) Public investments



(c) Current government consumption



(d) Corruption



(e) Private investment

variables in equation (11). Although the results are in line with the theoretical predictions of the model, the plots also suggest existence of clusters of countries. These are apparent in panels (a) and (d), where the explanatory variables are the share of military spending in GDP and the dimension of general corruption. As Cuaresma and Reitschuler (2004) notes, marked non-linearities are likely to emerge when we specify a multivariate model and to allow for this we introduce interaction terms.

### 3.2 Methods

In this section we briefly review the econometric method used to estimate the growth equation (11), by a dynamic panel data approach, see Arellano and Bond (1991), Arellano and Bover (1995), Blundell and Bond (1998). We include in equation (11) period dummies ( $\eta_t$ ) are used to control for time shocks, which might affect aggregate growth in any period but are not otherwise captured by the explanatory variables. Formally, the dynamic model is written as,

$$(12) \quad \gamma_{it} = \alpha_1 \gamma_{it-1} + \alpha_2 g_{invit} + \alpha_3 p_{invit} + \vec{\alpha}_4 X_{it} + v_i + \eta_t + \mu_{it}$$

where  $i$  represents the country and  $t$  represents the year ( $i = 1, 2, \dots, N; t = 1, 2, \dots, T$ ). Thus,  $\gamma_{it}$  is the average annual growth for country  $i$  during period  $t$  and  $\gamma_{it-1}$  is the value of the variable at time  $t - 1$ .

$X_{it} = [g_{mil}, g_{cons}, corr, g_{milcorr}, g_{invcorr}]$  is a vector of exogenous covariates,  $g_{inv}$  is assumed to be a predetermined variable<sup>7</sup> and  $p_{inv}$  is specified as an endogenous variables. It is worth noting that the endogeneity of  $p_{inv}$  does emerges from the model, notably from the capital accumulation process in equation 4. In addition, the fixed effects  $v_i$  and the idiosyn-

---

<sup>7</sup>Statistically, we define  $x_{it}$  as a predetermined variable when the error term at time  $t$  has some feedback on the subsequent realizations of  $x_{it}$ . Hence, for predetermined variables we have that  $E[x_{it}, \epsilon_{it}] \neq 0$  for  $s \leq t$  and  $E[x_{it}, \epsilon_{it}] = 0$  for  $s > t$ .

cratic shocks  $\mu_{it}$  have to be orthogonal components, with the following moment conditions:

$$E[\mu_{it}] = E[v_i] = E[\mu_{it}v_i] = 0$$

Although, the GMM estimators used below may account for endogeneity, it could still be a potential problem in inference. We make the channel by which private investment ( $p_{inv}$ ) can be affected by economic growth explicit, by estimating an auxiliary dynamic model using the System GMM estimator (Blundell and Bond, 1998). The model is written as,

$$(13) \quad p_{inv_{it}} = \delta_{11}p_{inv_{it-1}} + \omega_{11}G_{it} + u_i + \varepsilon_{it}$$

where  $G_{it} = [open, stability, g_{inv}, corr]$  is a vector of exogenous variables that the literature in this field has found to affect the decisions of private investments (see, for example Ndikumana and Balamoune-Lutz, 2008).  $u_i$  is the fixed effect and  $\varepsilon_{it}$  are the idiosyncratic shocks<sup>8</sup>. As a second stage, we include in equation (12) the predicted values of investment as an exogenous predictor for growth,  $\widehat{p_{inv_{it}}}$ .

In order to estimate (12), we use the Arellano and Bond (1991) first difference estimator that corrects not only for the bias included by the lagged endogenous variable, but also permits us to specify and test different forms of endogeneity in the other regressors. The resulting generalized method of moments (GMM) estimator in first-differences eliminates country specific effects, using all possible lagged values of each of the variables as instruments. More specifically, as suggested by Arellano and Bond we rewrite equation (12) as:

$$(14) \quad \Delta\gamma_{it} = \pi_{11}\Delta\gamma_{it-1} + \alpha_2\Delta g_{inv_{it}} + \alpha_3\Delta\widehat{p_{inv_{it}}} + \alpha_4\Delta X_{it} + \Delta\mu_{it}$$

where all variables are now expressed as deviations from period means and  $t = 3, \dots, T$ . Of

---

<sup>8</sup>As Roodman (2009) discusses, system GMM does not contain a feasible efficient one-step weight matrix H, so in the difference GMM below we use the two-step estimations.

central interest here is the set of internal instruments used<sup>9</sup>, which requires us to determine whether the explanatory variables are strictly exogenous or predetermined. We use the theoretical structure of the model to deal with this issue.

Let  $\Delta y_i = [\Delta\gamma_3, \dots, \Delta\gamma_T]$ ,  $\Delta X_i^* = [\Delta\gamma_{i-1}, \Delta g_{inv_t}, \widehat{\Delta p_{inv_t}}, \Delta X_t]$ ,  $\beta^* = [\pi_1, \alpha_2, \alpha_3, \alpha_4]$  and  $Z_i$  be a  $(T-2) \times l$  stacked matrix of instruments, the GMM estimator of equation(14), based on the orthogonality condition  $E[Z_i \Delta\mu_{it}] = 0$  is given by:

$$(15) \quad \beta_{GMM}^* = \left[ \left( \sum_{i=1}^N Z_i' \Delta X_i^* \right)' V^{-1} \left( \sum_{i=1}^N Z_i' \Delta X_i^* \right)' \right]^{-1} \\ \times \left( \sum_{i=1}^N Z_i' \Delta X_i^* \right)' V^{-1} \left( \sum_{i=1}^N Z_i' \Delta y_i \right)'$$

where  $V$  is the weighting matrix that can be computed by a one step GMM estimator of the form  $\hat{V}_1 = 1/N \sum (Z_i' H Z_i)$  in which  $H$  is  $(T-2)$ . In this paper we estimate the one and two-step GMM estimators, but only report adjusted standard errors from the second step, using the finite-sample correction proposed by Windmeijer (2005). After some experimentation with the matrix of instruments, we report estimates using the following two mixed matrices of instruments (in our model  $T=5$ ), where strictly exogenous variables are treated in the traditional way and predetermined variables are stacked to give:

$$Z_i = \begin{bmatrix} Y_{i1} & 0 & 0 & (\Delta X_{i3}^1, X_{i3}^2)' \\ 0 & Y_{i1}, Y_{i2} & 0 & (\Delta X_{i4}^1, X_{i4}^2)' \\ 0 & 0 & Y_{i1}, Y_{i2}, Y_{i3} & (\Delta X_{i5}^1, X_{i5}^2)' \end{bmatrix}$$

where  $Y_{it} = [\gamma_{it-1}, g_{inv_{it}}]$  is the vector of predetermined variables,  $\Delta X_{it}^1 = [\widehat{p_{inv}}, g_{mil}, g_{inv}, g_{cons}]$  is a vector first-difference exogenous covariates, while  $X_{it}^2 = [corr, g_{milcorr}, g_{invcorr}]$  is a vector of exogenous variables in levels. This specification is in the spirit of Holtz-Eakin, Newey and Rosen (1988) approach of including external instruments to provide more efficient estimations.

---

<sup>9</sup>The choice of the number of instruments to use for the estimation is not a trivial issue because of the trade-off between efficiency and bias (Roodman, 2009).

The validity of these instruments can then be tested using Arellano and Bond's (1991) Sargan test. In the dynamic specification, the consistency of the GMM systems estimator depends on the validity of the assumption of no serial correlation of the error terms. We investigate this by using the test by Arellano and Bond (1991), which was specifically developed for dynamic panel models under GMM and tests for the presence of second-order serial correlation in the first differenced error term.

## 4 Results

In table 1, we present the estimation results for the growth rate equation (9). We use the estimations in the first column (I) as a benchmark model with the indicator of corruption variable (*corr*), that it is assumed to affect the proportion of the components of public spending in GDP. In columns (II) and (III), we report parameter estimates of extended models that include the interaction terms for the military sector and public investment. The results show the coefficient estimates for the components of government spending and corruption to be significant and have the expected signs. Increasing the shares of military spending, current government consumption and corruption lead to decreases in the growth rate, while increases in public and private investment yields an increase in the cross-country economic growth rate.

As noted, corruption, as well as decreasing economic performance directly, can also increase the amount of rent-seeking activity, which may reduce higher productivity activities *i.e.* public investments. Support for this prediction is evident in estimations II and III, where the interaction variable  $g_{milcorr}$  is positive, while  $g_{invcorr}$  is significant in specification III. The magnitude of the impact of  $g_{milcorr}$  is in line with that obtained by Gupta *et al.* (2001) and similar for both specifications. This suggests that there exist complementary effects between the military sector and corruption that have additional effects on economic growth to corruption per se.

These results imply that for these African countries, corruption leads to increases in military spending, worsening the negative impact of the larger military sector on the economy's growth rate. Furthermore, the positive impact of  $g_{inv}$  on the GDP growth rate appears to be constrained by the interaction variable ( $g_{invcorr}$ ). Thus, the existence of corruption leads to a re-allocation of resources from more productive sectors towards less productive ones. As military spending generates more rents, projects in this sector are likely to involve larger amounts of money and to attract more and larger bribes (Delavallade, 2005).

Table 1: Estimation results

	I	II	III
$\gamma_{t-1}$	0.171 (0.150)	0.146 (0.150)	0.159 (0.138)
$p_{inv}$	0.073 (0.050)	0.095 (0.056)	* 0.081 (0.052)
$g_{cons}$	-0.358 * (0.200)	-0.451 ** (0.196)	-0.348 * (0.180)
$g_{inv}$	0.893 ** (0.395)	1.318 *** (0.426)	0.687 ** (0.294)
$g_{mil}$	-0.883 ** (0.413)	-1.268 ** (0.493)	-0.949 ** (0.444)
$corr$	-0.013 * (0.009)	-0.037 * (0.019)	-0.021 (0.021)
$g_{milcorr}$		0.957 *** (0.338)	0.933 ** (0.385)
$g_{invcorr}$			-0.172 * (0.079)
First order Arellano-Bond test	-1.736 * (0.082)	-1.817 * (0.069)	-1.805 * (0.070)
Second order Arellano-Bond test	-1.553 (0.120)	-1.608 (0.107)	-1.527 (0.126)
Sargan Test	14.006 (0.525)	15.685 (0.403)	14.128 (0.515)
N	123	123	123

*Note:* The dependent variable is the growth rate of GDP, ( $\gamma$ ). Estimations are two-step Difference GMM with the Windmeijer (2005) correction. In parentheses we report the standard errors, while the asterisks stand for the p-value significance levels \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 2 presents the estimated elasticities for the government spending components and corruption, together with bootstrap standard errors based on 10,000 replications. The val-

ues of the elasticities show the effect of corruption and the government spending components, plus the effects of corruption in the public sector, for both the military sector and public investment<sup>10</sup>. As Gupta et al. (2001) argue, the political decisions that allocate government expenditure among the components of public spending, involve corrupt public officials, prescriptions and regulations that already exist.

The estimated elasticity for corruption is large ( $-0.53$ ) and its magnitude depends on the non-linear effects of military spending when public investments are kept constant. This measure seems reasonable for African countries for at least two reasons. First, we found a significant and positive impact on growth rate of a unit decrease in corruption, although smaller than the Mauro (1995), Mo (2001) and Pellegrini and Gerlagh (2004) results obtained with larger cross country datasets. In fact our GMM estimator allows us to treat the endogeneity in some explanatory variables consistently and so avoids issues linked with 'overestimation' of OLS parameters<sup>11</sup>. Secondly, the existence of weaker institutions in Africa, on average, means that corruption can work as a second-best solution to market distortions imposed by government procedures and policies, at least in the short run. This positive effect may partly counterbalance the negative impact of corruption on economic performance in the long run.

Changes in military spending are found to have a similar effect on growth ( $-0.56$ ). This is consistent with the argument that rent-seeking in the military sector feeds corrupt practices, supporting the case for political intervention that directly leads to a cut of the share of military spending in GDP to enhance the economic performance. From a policy-makers point of view, if the resources from the military are devoted to other government sectors, there will be an increase in real per capita growth, conditional on the level of corruption.

Table 2 also present the estimated elasticities for two sub-samples of countries, those with high military burden, above the median, and those with low military burden, below the median. The estimated values for corruption in both sub-samples are similar to those for

---

<sup>10</sup>For example, the elasticity of military spending on GDP is calculated as:  $de_{g_{mil}} = \beta_{g_{mil}}(M(g_{mil})/M(\gamma))$  where  $M$  represents the mean value of the variable and  $\beta_{g_{mil}}$  is the estimated parameter.

<sup>11</sup>It is worth noting that the results obtained with IV estimator from the same authors gave an insignificant impact of corruption on per capita growth rate.

the total sample, whereas the values for the military sector shows marked differences, with the negative elasticity estimate much higher in absolute terms for the countries in the high military spending group. The results of this sensitivity analysis shows the value of trying to disentangle the effect of complementarities between the military sector and corruption as well as supporting our previous conclusions.

Table 2: Estimated elasticities, full and sub-samples of African countries

Endogenous	Exogenous variables					
Variable	Military Sector			Corruption		
	Full sample	Low-military sample	High-military sample	Full sample	Low-military sample	High-military sample
$\gamma$	-0.557*** (0.12)	-0.371*** (0.09)	-0.834*** (0.38)	-0.531*** (0.22)	-0.568*** (0.28)	-0.487*** (0.21)

*Notes:* The asterisks stand for the p-value significance levels. We have that \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . In parentheses we provide bootstrap standard errors. The proposed elasticity measures are referred to the second column of Table 1.

## 5 Conclusions

Corruption in developing countries is generally accepted to be an important obstacle to economic growth, but there have been relatively few attempts to identify the specific manner in which this may occur. In this paper an endogenous growth model that allows corruption to act on economic growth, through interactions between the military sector and civilian spending is developed and estimated on a panel of African countries over the period 2003-2007. The results confirm the predictions of the endogenous growth model that while government investment expenditure enhances economic growth, large military burdens and high current government spending and corruption can reduce it.

The estimated elasticities for the full sample and for subsamples of countries with high and low levels of military spending, showed that cuts in military spending are likely to directly increase aggregate economic performances and to indirectly stem the effects of corruption. Overall, the results provide strong evidence that, for the group of African countries studied here, high levels of defense spending and corruption have had a damaging effect on economic performance, both directly and indirectly.

## Appendix 1 -Descriptive statistics

<i>Country</i>	$\gamma$	$g_{mil}$	$p_{inv}$	$g_{cons}$	$g_{inv}$	$corr$
Algeria	4.466	3.110	10.270	21.032	13.825	64.516
Angola	15.265	3.715	7.910		3.841	93.533
Benin	3.800	1.016	6.187	18.765	11.977	68.800
Botswana	4.991	3.120	9.176	26.421	10.751	19.633
Burkina Faso	5.533	1.173	7.060	28.584	10.960	47.850
Burundi	2.946	6.190	8.090	24.847	1.980	85.933
Cameroon	3.426	1.388	2.405	10.878	15.461	85.466
Cape Verde	5.711	0.670	9.715	27.181	22.425	31.216
Central African.Rep.	0.569	1.147	3.185	13.792	4.850	89.066
Chad	10.928	1.206	8.940	13.833	22.625	91.033
Comoros	1.808		5.350		5.335	74.383
Congo. Dem.Rep.	5.655	2.162	2.146	7.435	9.183	97.250
Congo. Rep.	3.745	1.544	7.841	21.204	15.810	86.166
Cote d'Ivoire	0.246	1.548	2.898	9.612	7.086	88.933
Djibouti	3.603	4.280	8.040	28.480	14.093	66.866
Egypt. Arab Rep.	4.811	2.961	7.118	16.505	9.698	59.116
Equatorial Guinea	13.271		12.663		31.185	98.616
Eritrea	1.493	24.005	16.835	43.460	5.051	50.833
Ethiopia	7.783	2.840	15.373	25.243	8.531	70.483
Gabon	2.221	1.508	4.263	12.136	19.665	70.900
Gambia. The	4.550	0.575	7.523	19.246	13.640	66.933
Ghana	5.650	0.645	12.146	23.388	15.326	50.616
Guinea-Bissau	0.416	3.456	11.595	22.623	2.471	86.816
Guinea	2.658	2.473	3.708	8.886	8.741	80.983
Kenya	45.483	1.646	3.976	19.355	13.578	82.616
Lesotho	4.100	2.510	8.521	24.050	28.738	47.750
Liberia	-0.416	0.957			3.877	81.900
Libya	3.968	1.826				77.866
Madagascar	3.053	1.175	9.266	17.078	12.900	43.250
Malawi	4.190	0.920	6.162	17.082	14.694	76.883
Mali	4.660	2.160	7.728	15.191	14.376	57.250
Mauritania	5.153	3.876	8.103	28.272	23.121	48.733
Mauritius	3.901	0.185	7.625	21.185	15.203	32.500
Morocco	4.550	3.455	3.840	18.525	2.338	46.133
Mozambique	7.685	1.096	11.911	21.566	10.223	68.700
Namibia	5.053	3.030	7.543	29.656	19.220	41.150
Nigeria	6.728	0.806				93.133
Niger	3.725	0.987	7.292	18.505	8.717	82.850
Rwanda	5.855	2.213	7.243	17.271	12.945	57.233
Sao Tome&Prin.						64.766
Senegal	4.325	1.483	8.438	18.508	18.091	53.500
Seychelles	0.880	1.863	5.705	28.811	19.828	37.583
Sierra Leone	10.881	2.266	5.326	17.175	8.803	83.000
Somalia						98.783
South Africa	4.420	1.618	2.730	20.481	14.195	31.533
Sudan	7.566	3.862	4.991	11.280	12.475	93.200
Swaziland	2.673	1.870	10.326	30.096	7.428	60.333
Tanzania	6.808	1.133	7.070	20.834	10.584	70.516
Togo	2.890	1.573	3.622	12.576	17.052	78.966
Tunisia	4.870	1.572				36.866
Uganda	5.800	2.370	4.995	17.280	16.596	76.583
Zambia	5.201	1.762	8.130	16.567	14.625	74.766
Zimbabwe	-5.975	3.757	2.695	20.195	12.815	94.583

*Notes:* We define  $\gamma$  as the growth rate of per-capita GDP,  $g_{mil}$  as the share of military spending in GDP,  $p_{inv}$  as the share of private investments in GDP,  $g_{cons}$  as the share of current government consumption in GDP,  $g_{inv}$  as the share of public investments in GDP, and  $corr$  as the control of corruption index.

## References

- ACEMOGLU, D. and VERDIER, T. (1998). Property rights, corruption and the allocation of talent: A general equilibrium approach. *Economic Journal*, **108** (450), 1381–1403.
- AIZENMAN, J. and GLICK, R. (2003). *Military Expenditure, Threats, and Growth*. NBER Working Papers 9618, National Bureau of Economic Research, Inc.
- ARELLANO, M. and BOND, S. (1991). Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *Review of Economic Studies*, **58** (2), 277–97.
- and BOVER, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, **68** (1), 29–51.
- BARRO, R. J. (1990). Government spending in a simple model of endogenous growth. *Journal of Political Economy*, **98** (5), S103–26.
- BLUNDELL, R. and BOND, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, **87** (1), 115–143.
- CUARESMA, J. C. and REITSCHULER, G. (2004). A non-linear defence-growth nexus? evidence from the us economy. *Defence and Peace Economics*, **15** (1), 71–82.
- DELAVALLADE, C. (2005). Corruption and distribution of public spending in developing countries. *Journal of Economics and Finance*, **30** (2).
- (2007). *Why do North African firms involve in corruption ?* Documents de travail du Centre d’Economie de la Sorbonne v07002, Université Panthéon-Sorbonne (Paris 1), Centre d’Economie de la Sorbonne.
- DEVARAJAN, S., SWAROOP, V. and HENG-FU, Z. (1996). The composition of public expenditure and economic growth. *Journal of Monetary Economics*, **37** (2-3), 313–344.

- DREHER, A. and HERZFELD, T. (2005). *The Economic Costs of Corruption: A Survey and New Evidence*. Public Economics 0506001, EconWPA.
- GUPTA, S., DE MELLO, L. and SHARAN, R. (2001). Corruption and military spending. *European Journal of Political Economy*, **17** (4), 749–777.
- GURIEV, S. (2004). Red tape and corruption. *Journal of Development Economics*, **73** (2), 489–504.
- LEE, J.-H. (2006). Business corruption, public sector corruption, and growth rate: time series analysis using korean data. *Applied Economics Letters*, **13** (13), 881–885.
- MARIANI, F. (2007). Migration as an antidote to rent-seeking? *Journal of Development Economics*, **84** (2), 609–630.
- MAURO, P. (1995). Corruption and growth. *The Quarterly Journal of Economics*, **110** (3), 681–712.
- (1998). Corruption and the composition of government expenditure. *Journal of Public Economics*, **69** (2), 263–279.
- NDIKUMANA, L. and BALIAMOUNE-LUTZ, M. (2008). *Corruption and Growth: Exploring the Investment Channel*. Working Papers 2008-08, University of Massachusetts Amherst, Department of Economics.
- NYE, J. S. (1967). Corruption and political development: A cost-benefit analysis. *The American Political Science Review*, **61** (2), 417–427.
- PELLEGRINI, L. and GERLAGH, R. (2004). Corruption’s effect on growth and its transmission channels. *Kyklos*, **57** (3), 429–456.
- ROODMAN, D. (2009). A note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics*, **71** (1), 135–158.

- SHIEH, J.-Y., LAI, C.-C. and CHANG, W.-Y. (2002). The impact of military burden on long-run growth and welfare. *Journal of Development Economics*, **68** (2), 443–454.
- TANZI, V. (1998). *Corruption Around the World - Causes, Consequences, Scope, and Cures*. IMF Working Papers 98/63, International Monetary Fund.
- TRANSPARENCY INTERNATIONAL, T. (ed.) (2002). *Corruption in the Official Arms Trade*, TI(UK) London.
- WINDMEIJER, F. (2005). A finite sample correction for the variance of linear efficient two-step gmm estimators. *Journal of Econometrics*, **126** (1), 25–51.