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Corruption, taxation and economic growth:

theory and evidence

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Abstract:

In this paper, we analyze the interaction between corruption, taxation and economic growth. Our contributions are twofold. Theoretically, in an endogenous growth model, we introduce corruption in two different ways: corruption in the public expenditure and corruption in the public revenue. We show two opposing effects. Under certain conditions, corruption can affect growth rate positively but it can also exert a negative effect via fiscal revenue. Not only does it tend to make the tax rate, which maximizes the long run growth rate sub-optimal, but it can also create distortions that can lead to excessive tax rates harmful to growth.

The empirical analyses are based on non parametric estimates as well as econometric investigations. Our results support the assumption of a non linear relationship between public resources and growth. Interactions between public resources and institutional variables evidence the following the results: (i) the more countries are corrupt the stronger the negative effects of taxation on the growth (ii) Once the negative effects of corruption are accounted for, our data do not support a potential positive effect of corruption on economic growth.

Key words: Corruption, taxation, growth, developing countries

JEL classifications: H2, O43.

Introduction

Recent studies have showed that corruption i) reduces public tax revenues (Ghura, 1998; Tanzi and Davoodi, 2000; Attila et al, 2008; ii) has adverse effect on the tax morality of taxpayers (Torgler, 2004, 2005, 2007); iii) and distorts a country's tax structure. These various findings suggest that there are three mechanisms by which corruption in fiscal administration affects economic growth. Firstly, by decreasing the resources available for public authorities, corruption will reduce the productive public investments in such areas as roads, health and education. This effect is accentuated since the tax morale of economic agents is affected. Secondly, by worsening the distortions on the level of taxation and its structure, corruption reduces growth more than the harmful effect of taxation alone. Lastly, by allowing economic agents, in particular private companies to reduce their fiscal burden, corruption can have an indirect "positive effect" on growth if the revenue from unpaid taxes is then used to finance new investments[1].

This paper intends to disentangle both the positive effects and negative effects stemming from the interaction between corruption, public resources and growth. Addressing such an issue is critical for efficient public policy in developing countries. Reducing corruption results in better good governance and greater transparency in public finance management and hence increases public resources. However, consistent with the "Laffer curve[2]", increasing tax pressure could lead to adverse effects on economic activities. Hence, even though increases in public resources are likely to help governments in providing quantitatively and qualitatively more public goods, these benefits may be offset by negative effects on growth due to higher taxes. As regards the two opposing effects, a tradeoff is needed. How optimal should taxation be if corruption has a greatly detrimental effect on fiscal policy? How can anti-corruption policy and fiscal policy be reconciled in order to stimulate economic growth? Theoretical and empirical investigations should provide greater insight into these problems.

The contribution of this paper is twofold: theoretical and empirical. From the theoretical point of view, this paper is an extension of previous works by Barreto and Alm (2003) and Coppier (2005) who analyzed the interactions between corruption, taxation and growth. It differs in modeling corruption in two ways: bribes taken from public expenditure and bribes taken from public fiscal revenue in an endogenous growth model. Coppier (2005) considers that corruption affects the profits

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[1] Such an effect is line with the theory of beneficial corruption developed by Leff (1964), Nye (1967) suggesting that corruption might actually enhance efficiency when public regulation or bureaucracy is excessive. For a critique see Kurer (1993). Meon and Sekkat (2005), Meon and Weill (2006) have provided an empirical test of this theory. In particular, Meon and Sekkat estimates do not support the "grease the wheels" view of corruption.

[2] Strictly speaking the Laffer curve relates tax revenues to the tax rate.

of private enterprises while Barreto and Alm (2003) define corruption as an indirect rent extracted by the public official, who creates a monopoly situation when providing some public goods. Coppier (2005) emphasized the importance of taking into account corruption in the explanation of the relation between taxation and growth, whereas Barreto and Alm (2003) focused more on the effects on welfare. In this study, we propose an alternative framework.

From an empirical point of view, unlike others studies the present work is based on non parametric estimates and an instrumental variable approach (Generalized Method of Moments). Many studies have analyzed the effects of taxation and tax structure or more particularly of tax policy on the growth (King and Rebelo, 1990; Martin and Fardmanesh, 1990; Barro and Salt-I-Martin, 1992; Easterly and Rebelo, 1993; Barro, 1997, 1998; Chen, 2003; Lee and Gordon, 2005). However, to our knowledge no econometric study has attempted to take into account the the effects of corruption in the explanation of the taxation and growth nexus. This study aims at filling this gap and thereby to connect two areas of investigation: the relation between corruption and public revenue and the effect of taxation on growth.

This paper is organized as follows. In section I we develop an endogenous growth model in which corruption is defined as a rent misappropriated from public expenditure and as rent taken from tax revenue. Section II and III are devoted to respectively empirical analyses and econometric results.

Section 1- Corruption, taxation and growth: the endogenous model of growth revisited

1.1- Theoretical framework and assumptions

Let us consider a production function of Cobb-Douglas type with a constant return scale:

$$y_t = Ak_t^{\alpha}\left[(1-b_g)g_t\right]^{1-\alpha} \qquad (1)$$

The rate of depreciation of k is δ. Production in the private sector requires the supply of public capital provided by the State. However public expenditure is affected by corruption so that only a proportion $(1-b_g)$ of public capital is available for production. This formulation of the function of production is based on Barro (1990) but the difference here is in b_g, which represents the proportion of productive public expenditure misappropriated by the public official in charge of their management. As formulated, the function of production is in line with that in the study of Del Monte and Papagni (2001), in which corruption appears as a direct theft of public property (Mauro, 1995). b_g can also be interpreted as a "public bad" resulting from the negative externality of public intervention. This modeling of corruption differs from that of authors like Coppier (2005), who posited that corruption affects the profits of the private enterprises and Barreto and Alm (2003), who considered it as an indirect rent taken by the public agent which creates a discretionary monopoly situation in the supply of public goods.

The government finances its public expenditure (g_t) and transfers (s_t) (considered to be exogenous) using the taxes levied on production revenue τ_t^y and the taxation on consumption (τ_t^c). Taxes are function of bribes. The budgetary constraint is written as:

$$g_t + s_t = \tau_t(b_\tau) \tag{2}$$

As in the study of Ellis and Fender (2006), the process of accumulation of public capital as thus described takes into account the existence of corruption, but unlike these authors, we rather consider that taxation is affected by corruption. This last assumption is more plausible, and consistent with the literature on tax avoidance and corruption (Chen, 2003; Coppier, 2005). If τ_e represents the actual tax rate which results from corruption, one can write:

$$\begin{aligned} \tau_e^y &= \tau_t^y(b_y) = \tau^y\left[1 - b_y(1-\beta)\right] \\ \tau_e^c &= \tau_t^c(b_c) = \tau^c\left[1 - b_c(1-\beta)\right] \\ \tau_t(b_\tau) &= \tau_e^y + \tau_e^c = \tau_t^y(b_y) + \tau_t^y(b_c) \end{aligned} \tag{3}$$

In the relation (3) τ_e^y and τ_e^y s are actual tax rates on income and consumption. These rates depend on two elements: $b_y > 0$ and $b_c > 0$ which are bribes respectively extracted on income tax and on consumption tax and $\beta > 0$ the proportion due to tax avoidance. The government finances its activities with income tax and consumption tax. The actual revenues from taxes are equal to:

$$\begin{aligned} \tau_e &= \tau_e^y y + \tau_e^c c \\ &= \left[1 - b_y(1-\beta)\right]\tau^y y + \left[1 - b_c(1-\beta)\right]\tau^c c \end{aligned} \tag{4}$$

The economy consists of n identical agents who are holders of the factors of production. They accumulate the capital, rent it to firms and decide on their choice of consumption, investment and allocation of the factors in order to maximize their intertemporal utility:

$$U = \int_0^\infty e^{-\rho t} U(c_t)\,dt \tag{5}$$

ρ designates the intertemporal preference rate. The function of utility is constant elasticity of intertemporal substitution (CES):

$$U(c_t)=\frac{(c_t)^{1-\theta}}{1-\theta}-1 \qquad \text{for } \theta\neq 1$$
$$U(c_t)=Logc_t \qquad \text{for } \theta=1 \tag{6}$$

θ is the inverse of the intertemporal elasticity of substitution.

At each period, the constraint of the economy's resources is given by:

$$\dot{k}_t=(1-\tau_e^y)y_t-(1+\tau_e^c)c_t-\delta k_t \text{ where } c_t \text{ is the private consumption} \tag{7}$$

1.2-Long run growth rate determination

The optimization problem of the representative consumer is thus:

$$\underset{\{c_t\}}{Max}\ \mathrm{U(c_t)}$$
$$\text{st: } \dot{k}_t=(1-\tau_e^y)y_t-(1+\tau_e^c)c_t-\delta k_t \tag{8}$$

Hence, households choose c and k so as to maximize (8) subject to the constraints (1) and (7)

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The Hamiltonian is written as $H(c_t,k_t,\lambda_t)=U(c_t)+\lambda_t\left[(1-\tau_e^y)y_t-(1+\tau_e^c)c_t-\delta k_t\right]$

The maximization conditions are the following:

$$\begin{cases}\dfrac{\partial H}{\partial c}=0\\ \dot{k}=\dfrac{\partial H}{\partial \lambda}\\ \dot{\lambda}=-\dfrac{\partial H}{\partial k}\end{cases}\Leftrightarrow\begin{cases}e^{-\rho t}u'(c_t)-\lambda(1+\tau_e^c)=0\ldots & (a)\\ \dot{k}=(1-\tau_e^y)y_t-(1+\tau_e^c)c_t-\delta k_t\ldots(b) & \\ \dot{\lambda}=-\lambda(1-\tau_e^y)f'(k)+\lambda\delta\ldots & (c)\end{cases} \tag{9}$$

From equation (a), we derive $\lambda=\frac{e^{-\rho t}u'(c)}{1+\tau_e^c}$. By differentiating λ with respect to time, we get: $\dot{\lambda}=\frac{1}{1+\tau_c^e}\left[-\rho e^{-\rho t}u'(c)+e^{-\rho t}\dot{c}u''(c)\right]$. Substituting λ and $\dot{\lambda}$ in equation (c) results in $\dot{c}=-\frac{u'(c)}{u''(c)}\left[\left(1-\tau_e^y\right)A\alpha\left(\left(1-b_g\right)\frac{g}{k}\right)^{1-\alpha}-\delta-\rho\right]$; from where taking into account the functional form of the function of utility, we determine:

$$\frac{\dot{c}}{c}=\gamma=\frac{1}{\theta}\left[\left(1-\tau_e^y\right)A\alpha\left(\left(1-b_g\right)\frac{g}{k}\right)^{1-\alpha}-\delta-\rho\right] \tag{10}$$

1.3- Interaction between corruption, taxation and growth

As described the model appears as a combination of the model of Chen (2003) which does not explicitly take into account bribes, and the model of Eichhorn (2004). From the government budget constraint, it follows that:

$$\frac{g}{k}=\tau_e^y\frac{y}{k}+\tau_e^c\frac{c}{k}-\frac{s}{k} \qquad (11)$$

Substituting (11) in (10) yields:

$$\gamma=\frac{1}{\theta}\left[A\alpha(1-\tau_e^y)\left(\left(1-b_g\right)\left(\tau_e^y\frac{y}{k}+\tau_e^c\frac{c}{k}-\frac{s}{k}\right)\right)^{1-\alpha}-\delta-\rho\right] \qquad (12)$$

Equation (12) is equivalent to the standard result according to which economic growth is a non linear function of income tax (Barro and Sala-i-Martin, 1996). Tax on consumption does not directly affect growth rate but indirectly through its effects on capital accumulation.

1.3.1- Effects of corruption

Corruption affects the long run growth rates in two ways: (i) by its impact on taxes rates and (ii) by its impact on public capital g[3].

In the regime without corruption, it stands that $\tau_e^y=\tau$ and the growth rate is higher than in the regime with corruption. In contrast if bribery is accepted- that is b_y and b_c vary – it can be easily shown that the effect of taxation on the growth rate is always negative but is of a smaller scale. Hence,

$$\frac{\partial\gamma}{b_y}=\frac{1}{\theta}A\alpha\left[(1-b_y)\left(\tau_e^c\frac{c}{k}-\frac{s}{k}+\tau_y\frac{y}{k}(1-\beta)\right)\right]^{-\alpha}$$
$$\left[(1-b_g)\frac{y}{k}(1-\alpha)(1-\beta)\left(1-\tau_y(1-\beta)\right)-(1-b_g)\left(\tau_e^c\frac{c}{k}-\frac{s}{k}+\tau_y\frac{y}{k}(1-\beta)b_y\right)\right]><0 \qquad (13)$$

[3] Our results are conditioned by two implicit assumptions: (i) consumption taxes are constant and (i) bribes paid on these tax revenue are constant.

Depending on the parameters of the model and the structure of the economy, equation (13) could be negative, positive or both. Thus, two effects are observable. On the one hand, individuals have strong incentives to accept and pay more bribes so as to diminish the tax burden. Therefore that opportunity allows them to increase their investments. On the other hand, the amount of taxes paid by the taxpayer being lower than the amount required[4], it follows that the economic agent increases his savings level and thereby accumulates more capital (Eichhorn, 2004).

In contrast, corruption in public spending negatively impacts on growth.

$$\frac{\partial \gamma}{\partial b_g} = -\frac{1}{\theta}\left(1-\tau^y\left[1-b_y(1-\beta)\right]\right)(1-\alpha)\frac{g}{k}A\alpha\left(\left(1-b_g\right)\frac{g}{k}\right)^{-\alpha} < 0 \quad (14)$$

$\forall \beta < 1$ and $b_y > 0$

Hence, productive public investment is reduced by corruption (Tanzi and Davoodi, 2000; de la Croix and Delavallade, 2006).

When the positive and negative effects of corruption are put together, we can derive the condition that allows the incidence of corruption to be minimized. By combining equations **Erreur ! Source du renvoi introuvable.** and (14), we can deduce the marginal rate of tax pressure $\hat{\tau}^y$ that makes it possible to cancel out the two opposing effects of corruption on growth:

$$\hat{\tau}_y = \frac{\left(\frac{g}{k}\right)^{\alpha-1}\left(1-b_g\right)^{\alpha}}{A\alpha(1-\beta)\left(1-(b_y+b_g-\alpha b_y\right)} \quad (15)$$

$\hat{\tau}_y$ is referred to as the optimal tax of corruption.

1.3.2- Optimal income tax and corruption: implication for growth

Let us consider that the aim of public authorities is to maximize the growth rate of consumption. Barro (1990) and Chen (2003) show that this optimization is equivalent to the maximization of well-being of the representative agent if (i) the rate of substitution between g and k is equal to unity and (ii) if the utility function is bounded, that is less than a certain limit. The first condition is verified since we use the production technology is assumed to have constant returns to scale. With regard to the second condition, Futagami al (1993), Greiner and Hanusch (1998) demonstrate that it is still not met. We assume therefore that it might not be essential for the optimization of growth. Derivation of the rate of growth with respect to consumption tax rate leads to the tax rate for which the growth rate is optimal[5]:

[4] Government tax revenues decrease in this case- a negative effect.

[5] Barro and Sala-i-Martin (1996) had showed that the optimal rate is given by $\tau^* = 1-\alpha$ which corresponds to the optimal size of the government.

$$\tau_y{}^* = \frac{1-\alpha+\frac{1}{y}\left(s-c\tau_c\right)}{2-\alpha} \tag{16}$$

Assume that the government chooses the tax rate at its optimal level τ_y^*. Recall that the actual optimal tax rate[6] is equal to $\tau_e^{y*} = (1-b_y(1-\beta))\tau_y^*$. Thus, any increase (decrease) in corruption tends to diminish (increase) the effective optimal income tax rate. As regards the impact of corruption on public capital, it noteworthy that for $b_g = 0$, all things being equal, the level of production increases. The right side term of the numerator in equation (15) becomes smaller, implying a lower optimal tax rate. This shows the adverse effect of corruption when the authorities ignore its actual magnitude. When targeting the optimal tax rate τ_y^*, public authorities only achieve a lower τ_e^{y*}, generating a sub-optimal growth rate.

1.3.3- Optimal corruption tax versus optimal growth tax

So far, we have established the optimal corruption tax $\hat{\tau}_y$ at which the effect of corruption on economic growth is nil. In comparison with t_y^*, two situations can arise if one takes into account the characteristics of the economy as defined from the model's parameters. These characteristics are influenced by the institutional context leading to inefficient policies.

Algebraically, the comparison between the two tax rates could result from many combinations of parameters or variables of the model. In figure 1[7] below, we represent the gap $\hat{\tau}_y - \tau_y^*$ as a function of b_g and b_y when $\alpha = 0.1\ g/k = 0.25;\ \beta = 0.9$ and $s\text{-}c\tau c = 75$. The graph 2 clearly shows the two plausible situations: $\hat{\tau}_y - \tau_y^* < 0$ ou $\hat{\tau}_y - \tau_y^* > 0$.

[6] In the event of all forms of corruption being absent, the optimal tax rate is given by:

$$\tau_y^*\Big|_{b_y=b_g=b_c=0} = \frac{1-\alpha+\frac{s}{y^*}}{2-\alpha}$$ with $y^* = Ak^{*\alpha}g^{*1-\alpha}$, k^*, g^* representing the optimal levels of g and k resulting from the maximization program of the representative firm

[7] z represents the growth rate (fig. 1)

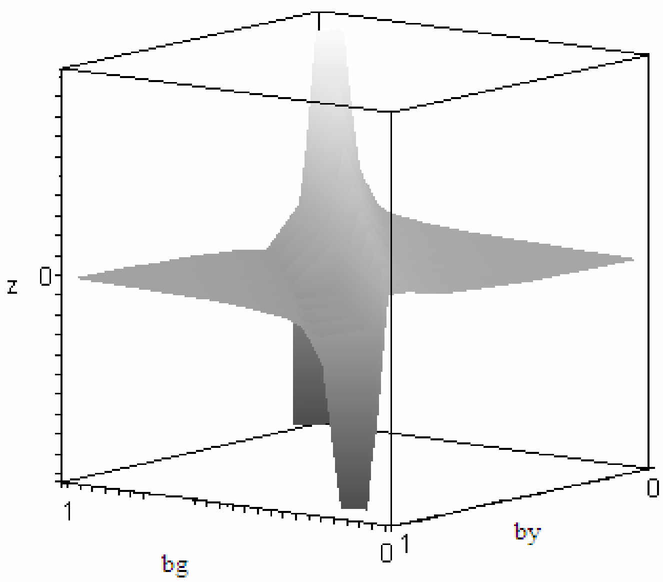


Figure 1: Gap between optimal corruption and optimal growth tax

In figure 2 below, we show these two situations with a third situation representing optimality without corruption.

1) The tax rate of optimal growth is lower than the optimal tax rate of corruption. In such a case, corruption induces a growth rate below the optimal rate, but the effects are simultaneous. Accordingly, any increase in the tax rate would have a direct negative effect on growth but a positive effect via the effect of corruption on growth (Barreto, 2000 ; Coppier, 2005). Symmetrically, any decrease in taxation is beneficial to growth though implying an adverse effect of corruption.

2) The tax rate of optimal growth is higher than the optimal tax rate of corruption. Compared to a corruption-free situation, the impact of taxation is more negative on growth since it significantly reduces the rate of growth. The positive direct impact or the indirect effect through corruption that taxes may have on growth is inhibited by the excessive negative effects.

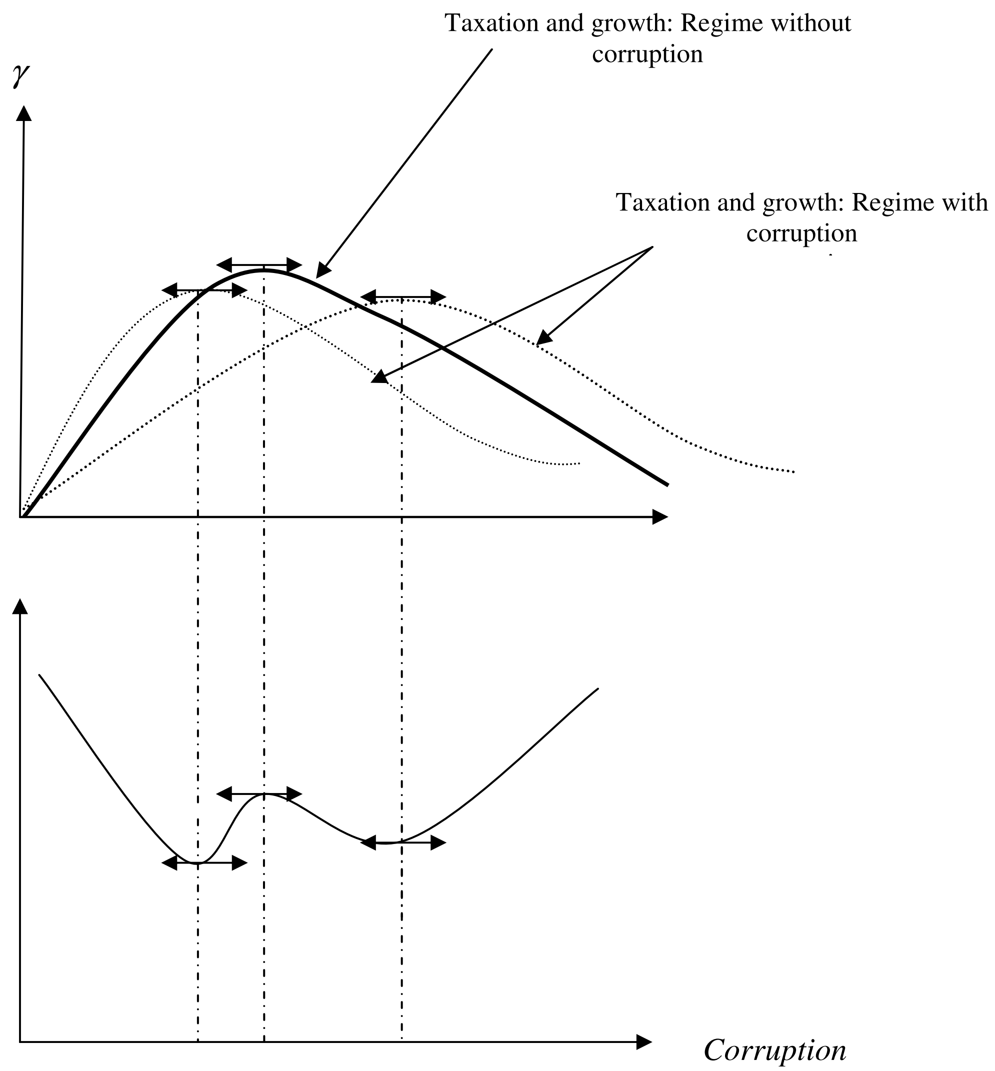


Figure 2: Optimal tax of corruption and optimal tax of growth

1.4- Implications of the model: testable hypotheses

Before turning to the empirical analyses, we can summarize the main results of the theoretical model and testable hypotheses.

First, all things being equal, economic growth in economies without corruption is higher than in most corrupt economies. However, from the optimum, any positive variation in the marginal rate of taxation induces a negative effect on growth which can be mitigated by the ability to pay bribes. Two hypotheses can be put forward:

Hypothesis H1: The impact of taxation on growth in non linear. A particular case is the Laffer curve within which the increase in tax rate below a certain threshold has a positive effect on growth.

Beyond this threshold, taxation is detrimental to growth. This is the result already established in the existing literature.

Hypothesis H2: The impact of taxation on growth is a decreasing function of corruption. Corruption has two opposing detrimental effects on the marginal tax rate, which allows optimization of growth: either corruption reduces the tax rate below the optimal level, or it excessively increases it beyond this threshold. Hence, the following hypothesis can be formulated:

Hypothesis H3: In either of the above regimes, and in comparison to a regime without corruption, the effect of corruption on growth is as follows. When the tax rate caused by corruption is lower than the optimal level, any increase in taxation causes a reduction in growth. However, when the tax rate involving corruption is higher than the optimal level, the effect of corruption is likely to promote higher growth rates.

Section 2- Empirical analysis of corruption, taxation and growth nexus

The empirical approach comprises two stages. First, we do a non-parametric analysis of the correlation between government revenue and growth. This approach aims at determining the nature of the relationship (increased, decreased or monotone) between the two variables. In the second phase, our approach is the Generalized Method of Moments (GMM).

2.1 Non-parametric analysis

The nonparametric approach aims to examine the relationship between the growth rate and taxation. Assume y_i to be the growth rate, x_i the government revenues. The relationship between these two variables is described by the function f defined as:

$$y_i = f(x_i) + \varepsilon_i \tag{17}$$

Unlike the parametric analysis, the non parametric regression estimates the function $f(x)$ with unknown functional form. This technique is an approximation of the true density $f(x)$. For some couples of observations $(x_i, y_i)...(x_N, y_N)$, the local weighted local estimator of $f(x)$ is given by:

$$\hat{f}_n(x) = \sum_{i=1}^{N} W_{ni}(x) y_i \tag{18}$$

where $(W_{n1}(x)...W_{NN}(x))$ is the vector of weight

The weight used in this study is that of Nadayara-Watson:

$$W_{ni} = \frac{\frac{1}{Nh} K(\frac{x_i - x_0}{h}) y_i}{\frac{1}{Nh} \sum_{i=1}^{N} K(\frac{x_i - x_0}{h})} \qquad (19)$$

K is Kernel function, h is the width of the window (bandwidth)

The Kernel function is assumed to be Gaussian.

The analysis concerns on six periods: 1980-1984, 1985-1989, 1990-1994, 1999-2000, 2000-2002 and 1980-2002. The variable of economic growth is from the World Penn Table 6.1. Unlike most studies using tax revenue, we measure taxation as total government revenue. Preference is given to total public revenue because it is less sensitive to the substitution effect involving the different components of public revenue (tax revenue and non tax revenue)[8] (Chambas, 2005). Hence, government revenues used in this paper include both tax revenues and nontax revenues of central governments and subnational government and social security contributions. Also, the ratio of public revenues to GDP reflects the average tax burden of the whole economy. Y-axis stands for the growth rates and the x-axis the log or public revenue.

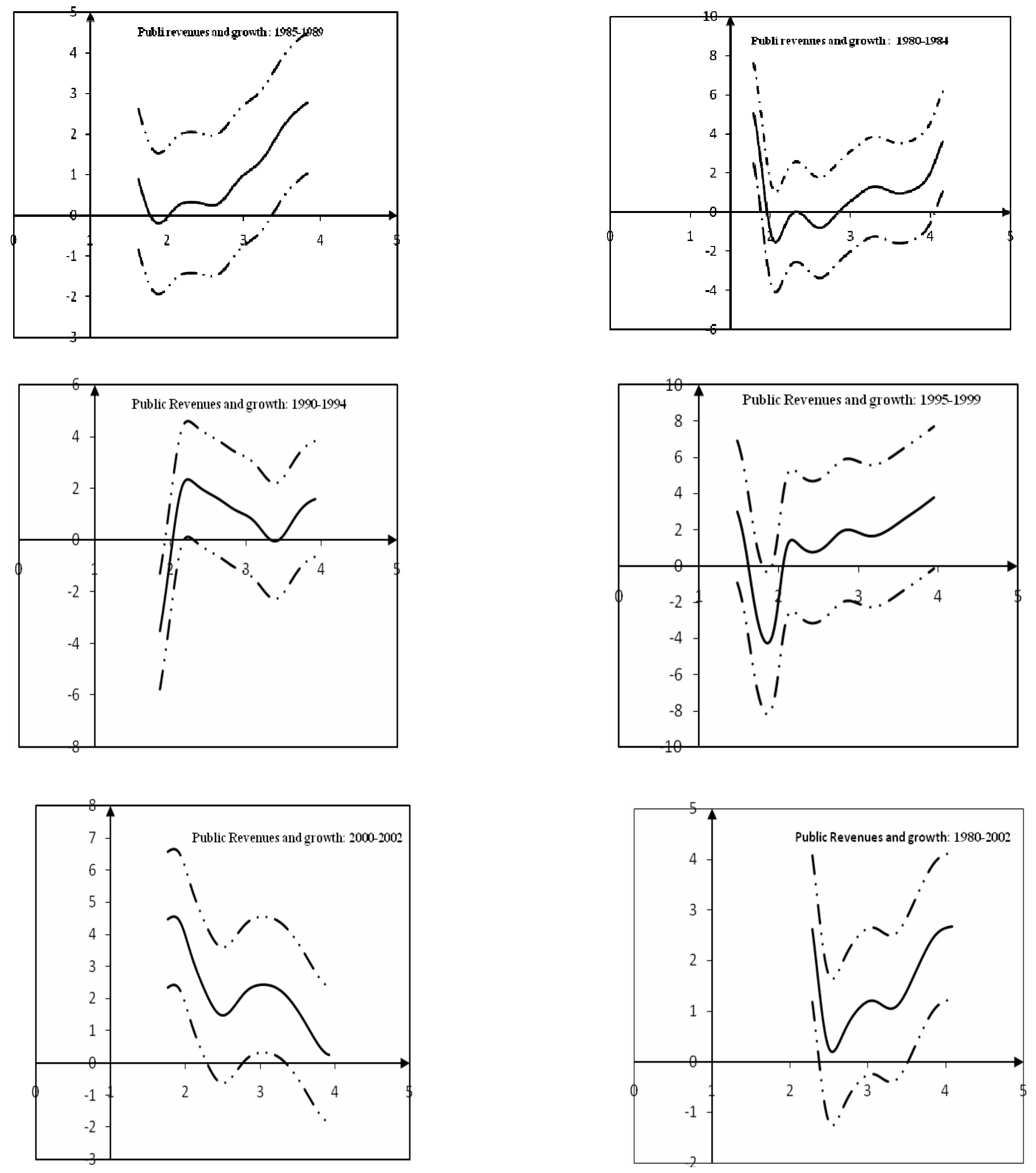
The results of nonparametric estimates are presented in figure 3 for each period of time as defined above. Dotted lines represent the upper and lower limits of the confidence interval at 5% level. The continuous lines represent the non parametric estimates. Y-axis and x-axis stand respectively for the growth rates and the log of public revenue ratio.

These charts evidence a non monotonous relationship between government revenue ratio and growth in all the six periods under consideration. In other words, the overall trend in the different curves is either increasing or decreasing relationship between tax revenue and growth. These results are consistent with the theoretical predictions described in section 1 (Hypothesis H1).

The non-parametric analysis is useful in detecting the nature of correlation between economic growth and government revenues. The non linear relationship may appear in different forms, depending on a set of many other factors determining economic growth. However, applying non parametric analysis with more than two variables is a little complicated. The following paragraph introduces an econometric analysis in order to disentangle the influence of corruption in the relationship between taxation and growth.

[8] While this substitution effect may be less observable in some developing countries, it is not the case in African countries. For example in Benin, Togo or Ivory Coast, with privatization, a cut in the dividend revenues (nontax revenue) from the enterprises with public participation leads to an increase in taxation of profits and capital gains in private sectors (tax revenue). The substitution effects were also perceptible when the levies on the “Caisse de Stabilization” had been suppressed in some countries in favor of taxes on exports.

Figure 3: Non Parametric analysis



2.2- The GMM approach

2.2.1- The approach

The estimated growth model takes the following form:

$$GROWTH_{it} = \beta_0 + \beta C_{it} + \gamma R_{it} + \gamma' R_{it} * C_{it} + \nu X_{it} + \delta Z_i + \mu_i + \varepsilon_{it} \qquad (20)$$

with $GROWTH_{it}$, C_{it}, R_{it}, X_{it} representing respectively growth rate, corruption, public revenue and the vector of other variables of control. Z_i is the vector of the time-invariant variables and μ_i the country specific effect. $\varepsilon_{it} \sim N(0,1)$ is the term of errors, i and t represent the individual countries and periods. The inclusion of the interactive term between public revenues and corruption expresses in part the non linearity relationship between taxation and growth.

The regressions are based on the Generalized Method of Moments (GMM) from a sample of 90 countries[9] covering the period 1980-2002. As the theoretical model show, corruption is endogenous. In the literature, corruption and institutional variables are generally considered endogenous (Mauro, 1995; Hall and Jones, 1999; Acemoglu et al, 2001; Dreher and Schneider, 2006) since they are likely to affect growth but conversely growth could help to build better institutions and hence reduce corruption[10].

2.2.2- Choice of Instruments

Several variables could be used as instruments of the variable of corruption. The list of instruments is as follows.

- Ethno-linguistic fractionalization: Used for the first time by Mauro (1995), this instrument has been used by other authors such as Neeman et al (2004), Dreher and Schneider (2006), Mocan (2004) and Mauro (1996). Exogeneity of ethno-linguistic fractionalization is supported by the fact that it has no direct impact on economic performance. Sala-i-Martin (1997) has shown in growth equations that the significance of this variable is not strong.
- French and British legal origin: An instrument used by Pelligrini and Gerlargh (2004), Neeman et al (2004), Dreher and Schneider (2006) and based on arguments and results provided by La Porta et al (1999). The authors argue that these variables are determined by historical institutional factors and hence are exogenous with respect to economic growth.
- Distance from equator and the mortality rate among settlers: These two variables are highly correlated and reflect the degree of influence of European culture in the former colonies

[9] The complete list of the countries is provided in appendix 1.
[10] Another possible source of endogeneity is the measurement errors in the corruption index, which is based on subjective opinions.

because of the climatic conditions and the incidence of tropical diseases in the colonized countries. The establishment of good institutions depends on these factors (Hall and Jones, 1999; Acemoglu et al, 2001).

With respect to the economic growth, it is questionable whether they are relevant and exogenous because they may directly affect economic growth. One example is the distance from the equator (Sala-i-Matin, 1997). However, the use of such variables as instruments of corruption in growth equations by other authors gives them reliability and credibility. In all the specifications, we provide the tests of over identification of Hansen-Sargan.

2.2.3- Other determinants of growth: variables of control

In addition to the variables of corruption and government revenues, we introduce a set of variables of control. Their inclusion is justified so as to avoid the bias on the coefficients of corruption and public revenues, our variables of interest. Not only do these variables are correlated with corruption and public revenues, but they also individually affect growth. The selected variables that are pertinent for the purpose of the present study are the following[11]:

1) Initial income in 1980 allows us to test the hypothesis of conditional convergence. A negative sign is expected for the coefficient associated with this variable.

2) Trade openness measured as the sum of exports and imports. The more open to the international market the economy is, the higher its growth rate is (Sachs and Warner, 1995). Further, trade policies seem to be one of the most important channel through which corruption affects growth (Pelligrini and Gerlagh, 2004). Thus, its omission could lead to bias.

3) Human capital as measured by the number of years of primary education and the number of years of secondary education and the growth rate of the population. Human capital is critical in increasing productivity. It is a decision variable for taxpayers (to pay or not taxes) since it determines the performance of public authorities in providing efficient education or health infrastructures, which in turn affect the tax morale of taxpayers.

4) Institutional and policy factors: We use the index of democracy and other institutional variables. Better institutional performance is expected to increase economic growth.

5) Public expenditure as measured by the share of government expenditure in final consumption in the GDP: its effects reflect the degree of public intervention in the economy. The sign expected for this variable can be positive or negative.

[11] For the definition of all the variables see appendix 2.

Section 3- Results of econometric estimations

3.1- Results from GMM

The results in table 1 are organized around two major points: the impact of taxation on growth and the influence of corruption in this interaction.

Government revenues negatively affect economic growth (Rebelo and Easterly, 1993; Blankenau and Simpson, 2004; Blankenau et al., 2007)[12]. Although this result is in line with theoretical predictions, it is important at this level to emphasize our contribution compared to the previous studies. In their study on tax policy and growth over the period 1970-1988, Easterly and Rebelo (1993) showed that the relationship between tax variables and growth is weak and that their significance depends on the variables of control. The authors explain this weakness by the multicolinearity among tax variables. The results of our study differ in several aspects.

The periods of study are not the same and hence our results (probably) reflect the characteristics of the countries in our sample over the period 1980-2002. In addition, our fiscal variables are not the same and from this point of view our study differs from that of Easterly and Rebelo (1993). These authors include in their models the marginal rate of income tax, the ratio of taxes on individual income to individual income and the ratio of taxes on consumption relative to consumption and investment. We look at overall revenues including both public income tax and non-tax revenues aggregated at the level of both central government and subnational governments and so avoided the problem of the substitution effect between the different components of public revenues common in developing countries (Chambas, 2005).

With regard to the impact of corruption, the coefficient of the interactive variable is negative and significant at the 5% level. In other words, in countries with high corruption, the negative impact of public resources on growth is greater. When public policy variables such as public spending on education, health and the infant mortality rate are included in our specifications, the coefficient of the variable corruption is positive and significantly different from zero at the 1% level (Column 2). This suggests that corruption has two effects on growth: a negative direct effect lowering both tax revenues and public expenditure, and an indirect positive effect positive once the adverse effects are accounted for. However, our estimations do not lend support to such an assumption and thus, hypothesis H3 is rejected.

The interaction between these variables and corruption in the explanation of the impact of taxation and corruption on growth is evidenced more clearly in columns (3) and (4). Excluding government spending on education and health from these specifications, the interactive term remains negative though not at the conventional levels of significance, but the variable of

[12] The authors include no institutional or governance variables in their specifications.

corruption becomes non significant. Given the non significance of the estimated coefficients, the results suggest that public spending on education and health have no direct impact on growth (Levine and Renelt, 1992). Landau and (1986) attributes the non significance of education spending to the inefficient use of public funds, of which large amounts are unproductive public expenditure and are not consistent with the objectives of growth (Miller and Russek, 1997).

Table 1: Dependent variable: Growth rate of real GDP per capita

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	IV-GMM	IV-GMM	IV-GMM	IV-GMM	IV-GMM	IV-GMM	IV-GMM
Log of GDP per capita in 1980	-0.754*	-0.676	-0.612	-0.763**	-0.704*	-0.688*	-1.033***
	(-1.77)	(-1.65)	(-1.45)	(-2.15)	(-1.80)	(-1.75)	(-2.92)
Corruption	0.665	0.873**	0.257	0.0182	0.0466	0.137	0.521*
	(1.46)	(1.99)	(0.73)	(0.063)	(0.15)	(0.51)	(1.66)
Public revenue /GDP (PR)	-1.538**	-1.801***	-1.189**		-0.739	-0.970*	
	(-2.10)	(-2.79)	(-1.97)		(-1.23)	(-1.78)	
Corruption*PR	-0.149**	-0.177**	-0.0874				
	(-2.04)	(-2.37)	(-1.35)				
Public expenditure	-0.447			-1.002**	-0.738		
	(-0.76)			(-2.16)	(-1.39)		
Education spending		0.801					-0.198
		(0.89)					(-0.22)
Health spending		-0.146					0.139
		(-0.25)					(0.23)
Infant mortality rate	-1.385***	-1.444***					-1.446***
	(-2.84)	(-2.80)					(-2.93)
Primary Education	-1.153**	-1.099**	-1.012**	-0.929**	-0.972**	-0.937**	-0.883*
	(-2.50)	(-2.25)	(-2.27)	(-2.14)	(-2.22)	(-2.11)	(-1.90)
Secondary Education	0.493	0.452	0.770**	0.709**	0.779**	0.766**	0.346
	(1.32)	(1.18)	(2.23)	(2.04)	(2.26)	(2.21)	(0.91)
Trade openness	0.840**	0.915**	0.692**	0.517**	0.626**	0.608**	0.442
	(2.53)	(2.46)	(2.19)	(2.11)	(2.24)	(2.11)	(1.52)
Private investment ratio	1.519***	1.497***	1.927***	1.779***	1.877***	1.891***	1.248**
	(3.26)	(3.15)	(4.39)	(3.88)	(4.28)	(4.30)	(2.51)
Growth rate of population	-0.530**	-0.545**	-0.817***	-0.784***	-0.821***	-0.859***	-0.573**
	(-2.31)	(-2.20)	(-4.14)	(-4.11)	(-4.23)	(-4.45)	(-2.55)
Index of democracy	0.0833	0.156	0.0316	0.0511	0.0500	0.0713	0.169
	(0.38)	(0.71)	(0.15)	(0.24)	(0.22)	(0.32)	(0.76)
Constant	11.77**	8.822	3.788	5.081	5.303	3.566	9.692*
	(2.05)	(1.56)	(0.81)	(0.96)	(0.98)	(0.75)	(1.85)
Observations	445	445	445	445	445	445	445
R-squared	0.09	0.03	0.15	0.15	0.15	0.14	0.07
J statistics of Hansen	3.418	2.465	7.090	6.188	6.914	7.004	2.462
(p-value de J)	0.332	0.482	0.0691	0.103	0.0747	0.0718	0.482

Robust statistics t of student in parentheses *** significant at 1%, ** significant at 5% ; * significant at 10%

3.2- Instrumenting both corruption and public revenue: three stage generalized least squares

In the previous section, only corruption was considered as an endogenous variable. However, the variable of government revenue can also be endogenous, as demonstrated in the theoretical models in section 2. Furthermore, two bodies of theoretical literature emphasize the endogeneity of the variables of tax policies (Rebelo and Easterly, 1993). On the one hand, the models of optimal tax policy assume a benevolent authority that maximizes the welfare of a representative household. In this context, taxes are not imposed on the economic agents but may result from an optimal choice of the public authorities. On the other hand, the political economy approach considers that public policies resulting from a political process (Alesina and Perotti, 1994), are not free of corrupt behavior. We therefore instrumented both variables at the same time by using the method of three stage generalized least squares (3SLS). We have three different equations: one for growth, one for government revenue and one for corruption. Each of these three variables is explained by its potential determinants (X_{it} et Z_i). The system of equation is:

$$\begin{cases} GROWTH_{it} = \alpha_g + \beta_g^{'} X_{git} + \psi_g R_{it} + \lambda_g C_{it} + \gamma_g Z_{gi} + \mu_{gi} + \varepsilon_{git} \\ R_{it} = \alpha_r + \beta_r^{'} X_{rit} + \lambda_r C_{it} + \gamma_r Z_{ri} + \mu_{ri} + \varepsilon_{rit} \\ C_{it} = \alpha_c + \beta_c^{'} X_{cit} + \gamma_c Z_{ci} + \mu_{ci} + \varepsilon_{cit} \end{cases} \qquad (21)$$

The method of three stages least squares (table 2)[13] leads to results consistent with those previously established (table 1). Different specifications demonstrate once again that government revenues negatively affect economic growth. The comparison of columns (1), (3) and (9) confirms the intuition of Easterly and Rebelo (1993) according to which there is a strong correlation between income tax variables and the initial revenue. The interaction of government revenue with corruption supports the hypothesis that the distorting effect of tax would be greater in highly corrupt countries. This interaction is influenced by the variables of public expenditure in education and health (see columns (5) and (7)), which mainly affect government revenue and have little or no effect on growth.

[13] To save space, the coefficients of the equation of corruption are not reported. Results are available upon request from the author

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	SYSTEM1		SYSTEM2		SYSTEM3		SYSTEM4		SYSTEM5	
	GROWTH	RT	GROWTH	RT	GROWTH	RT	GROWTH	RT	GROWTH	RT
Log GDP per capita in 1980			-1.007***					0.166***	-0.749**	0.155***
			(2.91)					(5.46)	(2.41)	(5.09)
Public Revenue/GDP (PR)	**-2.783****		**-0.336**		**-3.413*****		**-2.997*****		**-0.363**	
	(2.34)		**(0.25)**		**(2.83)**		**(3.00)**		**(0.28)**	
Corruption*PR					**-0.074**		**-0.058****		**-0.052***	
					(1.32)		**(2.05)**		**(1.85)**	
Corruption		**-0.018**		**-0.041**	**0.311**	**-0.011**		**-0.017**		**-0.015**
		(0.67)		**(1.56)**	**(0.95)**	**(0.62)**		**(1.00)**		**(0.87)**
Education expenditure	0.066	0.169*	-0.347	0.163*	0.489	0.170*		0.149		0.149
	(0.07)	(1.78)	(0.40)	(1.72)	(0.52)	(1.81)		(1.64)		(1.63)
Health expenditure	-0.469	-0.071	-0.100	-0.065	-0.617	-0.075		-0.097*		-0.100*
	(0.85)	(1.19)	(0.18)	(1.09)	(1.11)	(1.25)		(1.68)		(1.72)
Infant mortality rate	-0.592	-0.168***	-0.860**	-0.155***	-0.771*	-0.171***		-0.032		-0.044
	(1.61)	(5.22)	(2.24)	(4.91)	(1.76)	(6.25)		(0.90)		(1.25)
Investment ratio	1.181***		1.299***		1.264***		1.430***		1.494***	
	(3.52)		(3.91)		(3.70)		(4.38)		(4.54)	
Trade openness	0.750**	0.174***	0.390	0.164***	1.008***	0.177***	0.912***	0.159***	0.495	0.159***
	(2.15)	(5.63)	(1.09)	(5.27)	(2.64)	(5.94)	(2.71)	(5.48)	(1.40)	(5.47)
Primary education	-1.039**		-0.952**		-1.085**		-0.942**		-0.849*	
	(2.13)		(1.96)		(2.22)		(1.99)		(1.78)	
Secondary education	0.523		0.510		0.544		0.658*		0.646*	
	(1.51)		(1.49)		(1.56)		(1.93)		(1.90)	
Population growth	-0.702***		-0.685***		-0.684***		-0.832***		-0.856***	
	(3.40)		(3.34)		(3.27)		(4.40)		(4.54)	
Democracy	-0.180	-0.010	-0.145	-0.027	-0.047	-0.004	-0.164	-0.013	-0.110	-0.013
	(1.42)	(0.48)	(1.15)	(1.31)	(0.25)	(0.24)	(1.37)	(0.76)	(0.90)	(0.75)
Degree of monetization (M2/GDP)		0.068**		0.074**		0.066*		0.067**		0.077**
		(1.99)		(2.14)		(1.93)		(2.03)		(2.30)
Constant	8.689**	2.526***	12.327***	2.668***	8.411*	2.480***	5.687**	0.718	5.667**	0.821*
	(2.11)	(7.58)	(2.88)	(8.04)	(1.91)	(8.08)	(2.28)	(1.60)	(2.26)	(1.82)
Observations	445	445	445	445	445	445	445	445	445	445
R-squared	0.13	0.37	0.16	0.34	0.11	0.38	0.13	0.41	0.15	0.41

3.3- Further test with KKM (2003) data

The estimates presented here are based on the method of three stages least squares. As in subsection 4.1, the system of equations (21) is estimated. We have four periods corresponding to the data of KKM (2003): 1996, 1998, 2000 and 2002.

The results in Table 3 are as follows. First, the variable of public revenue is not significant even if its coefficient is positive. The coefficient of the variable of corruption is negative and significant depending on the model. This result could be explained by the interaction between the variables of corruption and public revenue but, as suggested by Renelt and Levine (1992), the discrepancy between the coefficient obtained in our study and the negative coefficient obtained from the ICRG data could be due to a difference in the data used.

A second result is irrefutable, however. The coefficient of the interaction term is significant and negative. This result is consistent with those obtained previously and is amplified by the adverse effect of corruption on public revenue. Finally, in comparison with the ICRG corruption variable, other variables in the model, including the trade openness, investment ratios are not significant.

Table 3 : Tests of robustness using KKM(2003) data (3SLS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	SYSTEM1		SYSTEM2		SYSTEM3		SYSTEM4		SYSTEM5	
	GROWTH	RT	GROWTH	RT	GROWTH	RT	GROWTH	RT	GROWTH	RT
Log GDP per capita in 1980			-1.151*		-1.091*					
			(1.66)		(1.68)					
Corruption		-0.169***	0.582	-0.203***		-0.064***	0.099	-0.041**		-0.041**
		(6.40)	(0.89)	(8.75)		(3.63)	(0.13)	(2.15)		(2.15)
Corruption*RT					-0.218***		-0.239		-0.222***	
					(3.33)		(1.50)		(3.54)	
Public Revenue/GDP (PR)	2.035		3.880		0.895		1.453		1.297	
	(1.06)		(1.38)		(0.42)		(0.74)		(0.73)	
Public expenditure/GDP							-1.566		-1.588*	
							(1.60)		(1.70)	
Education expenditure	-0.083	0.119	-0.392	0.121	0.018	0.110		0.110		0.110
	(0.07)	(1.43)	(0.33)	(1.46)	(0.02)	(1.34)		(1.33)		(1.33)
Health expenditure	0.032	-0.040	0.837	-0.069	0.373	0.029		0.048		0.048
	(0.05)	(0.73)	(1.04)	(1.29)	(0.55)	(0.58)		(0.94)		(0.94)
Infant mortality rate	0.279	-0.020	0.023	-0.002	0.134	-0.066*	0.287	-0.078**	0.300	-0.078**
	(0.59)	(0.55)	(0.05)	(0.07)	(0.29)	(1.96)	(0.59)	(2.28)	(0.65)	(2.28)
Investment ratio	-0.421		0.043		-0.088		-0.425		-0.448	
	(0.64)		(0.06)		(0.13)		(0.63)		(0.70)	
Trade openness	0.492	0.145***	0.384	0.132***	0.931	0.187***	0.881	0.195***	0.874	0.195***
	(0.75)	(3.52)	(0.54)	(3.18)	(1.45)	(4.85)	(1.42)	(5.06)	(1.44)	(5.07)
Primary education	0.824		0.807		0.928		0.867		0.867	
	(1.00)		(0.96)		(1.13)		(1.07)		(1.07)	
Secondary education	-0.946		-0.313		-0.666		-0.956		-0.986	
	(1.51)		(0.41)		(1.05)		(1.35)		(1.57)	
Population growth	-0.143		-0.161		-0.202		-0.199		-0.198	
	(0.65)		(0.72)		(0.94)		(0.92)		(0.92)	
Democracy	0.108	-0.071***	0.568*	-0.095***	0.047	0.005	-0.026	0.021	-0.056	0.021
	(0.47)	(3.21)	(1.73)	(4.50)	(0.20)	(0.28)	(0.09)	(1.13)	(0.25)	(1.13)
Degree of monetization (M2/GDP)		0.042		0.026		0.075*		0.086**		0.086**
		(1.03)		(0.65)		(1.96)		(2.21)		(2.20)
Constant	-6.769	3.286***	-7.600	3.618***	6.313	2.291***	0.863	2.067***	1.774	2.067***
	(1.38)	(9.43)	(0.72)	(10.99)	(1.36)	(7.98)	(0.12)	(7.02)	(0.43)	(7.02)
Observations	365	365	365	365	365	365	365	365	365	365
R-squared	-0.02	0.11	-0.14	0.01	0.06	0.29	0.05	0.30	0.06	0.30

Conclusion

This paper analyses the corruption, growth and taxation nexus. Previous studies have shown the positive or negative relationship between taxes and growth. Our contributions are as follows.

We have extended these investigations by integrating corruption in an endogenous growth model in two ways: corruption in public spending and corruption in taxation. We showed two opposing effects. Under certain conditions, corruption can positively affect the rate of growth. The second effect of corruption, which seems to be the more devastating, is its negative impact on growth through taxes. Not only does it tend to make sub-optimal tax rate that maximizes the rate of growth in the long term, but it can also create distortions leading to excessive tax rates harmful to growth.

The other novel contribution of this work is the development of a non parametric analysis of the correlation between public revenue and growth. The non-parametric analysis suggests a non linear relationship between public revenue and growth. Furthermore, several specifications using the Generalized Method of Moments (GMM) and the three stages least squares (3SLS) make it possible to conclude that in the most corrupt countries there is a higher impact of taxation on growth. Even though our theoretical model suggests the existence of a beneficial effect of corruption in terms of economic growth, such an effect is not supported by our data.

The present paper can be extended by looking at the individual component of the tax structure and its relationship with corruption and economic growth. Consistent with the current tax transition reforms in developing countries, it is important to emphasize the effect of two tax components: value added taxes and taxes on international trade. Since VAT introduction imply trade tariffs reduction in developing countries under reform, future analyses might help evaluate how well the tax reforms perform in terms of economic activities development.

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Appendices

Appendix A1: List of countries

Algeria
Argentina
Australia
Austria
Bangladesh
Belgium
Bolivia
Botswana
Brazil
Cameroon
Canada
Chile
China
Colombia
Republic of Congo
Costa Rica
Cyprus
Denmark
Dominican Republic
Ecuador
Egypt.
Salvador
Finland
France *Gambia,
Ghana
Greece
Guatemala
Guyana
Haiti
Honduras
Hong Kong
Hungary
Iceland
India
Indonesia
Iran
Ireland
New Zealand
Israel
Italy Jamaica
Japan
Jordan
Kenya
Malawi
Malaysia
Mali
Malta
Mexico
Mozambique
Low Country
Nicaragua
Niger
Norway
Pakistan
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Portugal
Senegal
Sierra Leone
South Africa
Spain
Sri Lanka
Sweden
Switzerland
Syria
Thailand
Togo
Tunisia
Turkey
Uganda
United Kingdom
The United States
Uruguay
Zambia
Zimbabwe

Appendix A2- : Definition of the variables

Variables	Definition	sources
Public revenues	Fiscal revenue+ non fiscal revenue of central administration and subnational governments and social contributions of social security	Brun, Chambas et. al .(2005)
GDP in 1980	Real Gross Domestic Product (GDP) per capita (RGDPCH [17])	World Pen Table 6.1
Growth rate	Growth rate of real GDP	
Investment ratio	Investment divided by GDP (KI[24])	
Corruption	Subjective perception index of experts : acts of corruption in the political sphere and public administration (nepotism, patronage, favoritism, asking for bribes …) (rescaled from 0 (low corruption) to 10 (higher corruption)	ICRG, 2003
	Composite Index : Control of corruption (rescaled from 0 (low corruption) to 10 (higher corruption)	KKM(2003)
Public expenditure	General government final consumption expenditure (formerly general government consumption) includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defense and security, but excludes government military expenditures that are part of government capital formation. %GDP	WDI (2005)
Education expenditure	Public expenditure on education consists of public spending on public education plus subsidies to private education at the primary, secondary, and tertiary levels. %GDP.	
Health expenditure	Public health expenditure consists of recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds. %GDP	
Infant mortality rate	Infant mortality rate under 5 years old for 1000	
Trade	Sum of exports and imports of goods and services divided by GDP	
Foreign aid	Official development assistance +official aid % GNI	
Population growth	Annual population growth rate. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of the country of origin.	
Primary education	Number of years in primary education in the total population	Barro et Lee (2000)
Secondary education	Number of years in secondary education in the total population	
Ethnic Fractionalization	Probability that two randomly selected individuals will belong to different ethnic groups : $FRAC=1-\sum_{i=1}^{M}\left(\frac{n_i}{N}\right)^2$; M=number of ethnic groups, N= total population, n_i =number of people belonging to the i^{th} ethnic group	Alesina et al; (2003)
Religious fractionalization	Probability that two randomly selected individuals will belong to different ethnic groups :	
British legal origin	Equal to 1 if a country has a British legal system, zero elsewhere	La Porta et al. (1998)
French legal origin	Equal to 1 if a country has a French legal system, zero elsewhere	