Economics of Governance (2006) 7:245–269
DOI 10.1007/s10101-005-0008-2

ORIGINAL PAPER

Corruption, Growth, and Income Distribution: Are there Regional Differences?

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Received: 12 December 2003 / Accepted: 28 February 2005 /
Published online: 21 February 2006

Abstract This paper uses panel data from 61 countries at different stages of economic development over a 20-year period to investigate regional differences in the effect of corruption on economic growth and income distribution. Using two measures of corruption, we find that there are statistically significant regional differences in the growth and distributional impacts of corruption. The largest growth impact of corruption is found in African countries while OECD and Asian countries have the lowest growth impact. On the other hand, the largest distributional impact of corruption in found in Latin America. A 10% decrease in corruption increases the growth rate of income by about 1.7% in OECD and Asian countries, 2.6% in Latin American countries, and by 2.8% in African countries. A one standard deviation decrease in corruption decreases the gini coefficient of income distribution (0–1 scale) by 0.05 points, 0.14 points, 0.25 points, and 0.33 points in OECD, Asian, African, and Latin American countries, respectively. The results are robust to various specifications, measurement of corruption, measures of investment, as well as the conditioning variables. The results have interesting policy implications for economic growth, especially in low income countries with high rates of corruption.

Keywords Corruption · Degenerative corruption · Growth · Income inequality · Regional differences · Panel data · Africa · Asia · Latin America · Oecd

JEL Classification O1 · O55 · C33

1. Introduction

This paper investigates regional differences in the effects of corruption on economic growth and income distribution by estimating growth and income distribution equations that include

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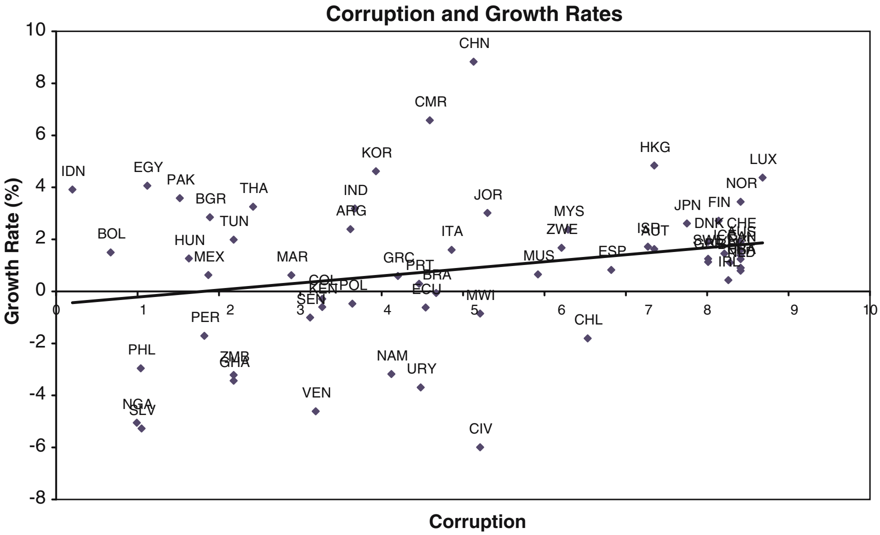

Fig. 1

corruption as an additional regressor and by allowing the coefficient of corruption to vary across regions of the world. For the purposes of this study, we divide the world into four regions – Africa, Asia, Latin America, and OECD. Although there are a few dissenting views on the impact of corruption on efficiency and income growth rate (Leff 1964), the preponderance of recent empirical research suggests that corruption retards the growth of income and may increase income inequality. What has not been investigated is whether the impact of corruption varies across regions of the world.

Although it is generally accepted that corruption has a negative effect on income growth, there are some exceptions. Some countries combine high corruption with slow income growth or stagnation; others combine high rates of corruption with fast income growth. Figure 1 is a scatterplot of TI corruption index and the average income growth rate of a sample of countries over the 1980–1998 period. The figure shows a very small positive relationship between honesty and economic growth. The figure shows regional differences in the growth effects of corruption. While African and Latin American countries combine high incidence of corruption with slow economic growth, several Asian countries in the sample combine high rates of corruption with high income growth rates. For example China (CHN) and Cote d'Ivoire (CIV) are ranked as equally corrupt, yet while China records an outstanding growth rate, Cote d'Ivoire records a large negative growth rate. Is the correlation between corruption and income growth rate in Figure 1 statistically significant? Are there statistically significant regional differences in the growth impact of corruption? If there are significant regional differences, what might account for these regional differences? This paper attempts to deal with some of these issues.

Shleifer and Vishny (1993) argue that uncoordinated bribery (corruption) is more damaging to growth than coordinated bribery. The nature of corruption may differ across regions of the world. For example, in most African countries, corruption is decentralized and uncoordinated with each agent exacting a bribe at every stage of a transaction without regard to whether the payer eventually succeeds in getting what he/she is trying to obtain. This type of corruption is quite different from the centralized "one stop" variety (where one pays a bribe at a centralized agency and gets what one wants) that is found in some parts of Asia. The growth impact of the former is likely to be more severe than the latter since the former is more fraught with uncertainty and delays than the latter. While economists recognize the role of corruption in economic performance, they have not investigated whether there are regional differences in the effects of corruption on economic growth and income distribution. Researchers have, generally, also not investigated the mechanisms through which corruption affects growth and income distribution. We attempt to do so in this paper.

Most researchers assume that corruption is exogenous and use cross-country data to investigate one aspect of the economic impact of corruption. This may not be the case; therefore we treat the exogeniety of corruption as a testable issue. We use panel data, a dynamic panel estimator and two measures of corruption in our investigation to ensure that our results are not driven by a particular measure of corruption we use. As far as we know, this paper is the only one that uses two measures of corruption, panel data, and a dynamic panel estimator to investigate regional differences in the effects of corruption on growth and income inequality in the same study. While a few studies have tried to link corruption to income distribution, none investigates regional differences in the effects of corruption on growth and income distribution in one paper.[1]

We find that there are statistically significant regional differences in the growth and distributional impacts of corruption. A 10% increase in corruption decreases the growth rate of per capita income by about 1.7% in OECD and Asian countries, by about 2.6% in Latin American countries, and by 2.8% in African countries. A one standard deviation increase in corruption increases the gini coefficient of income inequality by between 0.05 and 0.33 points. Our results suggest that the growth and distributional impact of corruption depends on the *character* rather than the level of corruption. We find that corruption affects economic growth directly and indirectly through reduced investment in physical capital. To the extent that rapid economic growth increases incomes of the poor and hence reduces poverty, increases in corruption additionally increases inequality through decreased growth. Our results are robust to various specifications of the growth equation and different measures of corruption.

The rest of the paper is organized as follows: section 2 provides a working definition of corruption and briefly reviews the literature on the economic consequences of corruption. Section 3 introduces the income growth and income inequality equations we estimate. The section also describes the estimation method for the growth equation. Section 4 describes the data while section 5 presents and discusses the statistical results. Section 6 concludes the paper.

2. Working definition and literature review

We take a purely economic rather than legal approach to the definition of corruption since not all corrupt practices are illegal and not all illegal activities are corrupt practices. For example, while a public official's use of private information about the location of a railroad to enrich himself may not be illegal, it nevertheless is a corrupt practice. We define corruption, in this paper, as the use of public office for private gain. We define public broadly to include private businesses, government, international organizations, and state-owned-enterprises (SOEs). Defined this way, corruption is a special case of the principal-agent problem with the general public as the principal and the public official as the agent. Jain (2001) identifies three

[1] See Gupta et al. (2002), Li et al. (2000), Johnston (1989), among others.

categories of corruption · grand, involving political elite; bureaucratic, involving corrupt practices by appointed bureaucrats; and legislative corruption, involving how legislative votes are influenced by the private interest of the legislator. The three types of corruption differ only in terms of the decisions that are influenced by corrupt practices. Our working definition of corruption is broad enough to encompasses all three categories of corruption.

Even with this narrow definition of corruption, there may still be problems of interpretation and measurement. For example, when does a "gift" to a public official become a bribe? To what extent is money given to an African public official to influence policy (generally considered bribery and therefore a corrupt practice) different from a contribution to a congressional campaign in the US (not considered bribery and therefore not a corrupt practice)? There is also the problem of common comparative measures. Suppose corruption takes the form of bribery. Does the extent of corruption depend on the absolute size of the bribe taken/given? To what extent is decentralized and competitive corruption more deleterious to growth and development than centralized corruption?

Economists generally see corruption as part of the problem of rent seeking (Acemoglu and Verdier 2000; Bardhan 1997; Barreto 2000; Ehrlich and Lui 1999; Gray and Kaufmann 1998; Tanzi 1998; Mauro 1995; among others).[2] Corruption slows economic growth because it distorts incentives and market signals leading to misallocation of resources. Second, corruption and the opportunities for corrupt practices lead resources, especially human resources, to be channeled into rent seeking rather than productive activities (Shleifer and Vishny 1993; Berthelemy et al. 2000; Gupta et al. 2000). Third, corruption is seen as an inefficient tax on transactions hence it raises the cost of production. Fourth, because corrupt practices are conducted in secrecy and contracts emanating from them not legally enforceable, it increases transactions cost. Fifth, corruption distorts the proper functioning of state institutions, allowing a few interest groups to seize these institutions for their private interest (Hellman et al. 2000). Finally and probably most important, corruption increases not only the cost of production but also uncertainty, especially in the case of decentralized corruption, hence decreasing investment in both physical and human capital (Wei 2000; Alesina and Weder 2000).

The growth impact of corruption is likely to be influenced by its *character* and *organization*. Wedeman (2002) characterizes corruption as either "degenerative" or "developmental". Degenerative corruption occurs when public officials use their positions to either loot the treasury or extort private property to build personal fortunes. Developmental corruption occurs when public officials provide resources and protection to private industry in return for part of the profits for political activities. Since the size of the "payment" public officials receive depends on the size and growth of profits in the private sector, it is in the best interest of public officials to pursue policies that encourage economic growth. On the other hand, because degenerative corruption leads to the erosion of property rights, it invariably leads to capital flight, capital consumption, and eventual stagnation of the economy. Whether corruption takes a degenerative or developmental form depends on the relative bargaining power of public officials and capital. Where public officials have more bargaining power than the business sector, corruption is likely to be of the degenerative type while the reversal of bargaining power is likely to produce developmental corruption. In Africa, Latin America, and the Caribbean where public officials tend to have strong bargaining power relative to business, corruption is of the degenerative type while in East Asia where capital is owned by ethnic Chinese, the threat of capital flight, should governments engage in degenerative corrupt practices, lead to developmental corruption.

[2] See Bardhan (1997), Jain (2001) and Lambsdorff (2001) for excellent reviews of the theoretical and empirical literature.

Another aspect of corruption that is likely to have differential growth impact in Asia and the rest of the developing world is how corruption is practiced – the "industrial organization" of corruption for lack of a better terminology. In Asia, corruption tends to be centralized and of the "one stop shop" variety; once a business person pays the "price", he/she gets the services he/she requests. In this regard, corruption in Asia acts as the price business pays for the use of productive public services. On the other hand, in other parts of the world, such as Africa, corruption is of the decentralized uncoordinated type with each bureaucrat acting as an independent contractor who demands a bribe at each stage of a multi-stage transaction.

There are several possible reasons why decentralized, uncoordinated corruption is likely to be more injurious to economic growth than centralized, coordinated corruption. Because there is no coordination, paying the bribe at any stage does not guarantee that one gets the service that one seeks. For example, in Ghana, it takes about ten different steps to obtain a deed to a property. At any stage, one has to pay a bribe without a guarantee that the service will be delivered. Assuming that the probability of "success" at any stage is 0.5 and is independent of "success" at other stages, the probability that one ultimately obtains the license after paying bribes at all stages is about 0.0001 compared to a centralized and coordinated system in which the probability of "success" is 0.5. In addition, because no particular or group of public officials is held accountable for the "success" of a transaction in a decentralized corrupt system, it provides incentives for public officials to demand bribes without delivering the service. This leads to multiple bribe payments at the same stage in the process, leading to long delays, increased cost, decreased output, hence slow economic growth. On the other hand, because a particular (group of) public official is held accountable to ensure "success" once a bribe has been paid in a centralized and coordinated corruption, there is incentive to ensure that the service is provided.

Mauro (1995, 1998) uses data from a sample of developed and developing countries to investigate the effects of corruption on economic growth. Using both ordinary least squares (OLS) and instrumental variables (IV) estimating techniques, he finds that corruption has a significantly negative impact on economic growth. Most of the growth impact, he finds, comes through decreased investment in physical capital. Shleifer and Vishny (1993) argue that corruption decreases economic growth and that uncoordinated bribery has a larger negative impact on growth than coordinated bribery taking. Bliss and Di Tella (1997) show that corruption increases the exit of firms, hence a decrease in production and economic growth.

Tanzi (1998) and Tanzi and Davoodi (1997) find that corruption increases total government expenditures but decreases expenditures on maintenance and this leads to reduced growth. They also find that corruption decreases private investment. Alesina and Weder (2000) investigate whether corrupt governments receive less foreign aid and conclude that corrupt governments do receive *more* foreign aid under some circumstances. Wei (2000) finds that corruption has a negative impact on the inflow of foreign direct investment (FDI), all things equal. Mo (2001) finds that corruption negatively affects economic growth with a 1 unit increase in corruption decreasing the growth rate of per capita income by about 0.6% points. Moreover, he finds that corruption affects economic growth mostly through increased political instability. Corruption is also likely to affect the quality of life, if not the growth rate of per capita income.

Del Monte and Papagni (2001) use panel data from Italian provinces and a dynamic panel estimator to investigate the effects of corruption on economic growth in Italy. They find that corruption has a significantly negative impact on the growth rate of income in Italy with an estimated growth impact of -0.145 per annum. They argue that corruption affects economic growth directly as well as indirectly through decreased private investment and reduction in public investment. However, their paper is limited to the Italian experience while our study uses cross-national time series data.

A few studies investigate the effects of corruption on income distribution.[3] Li et al. (2000) find that corruption increases the gini coefficient in a quadratic way; the gini coefficient is higher for countries with intermediate level of corruption while it is low for countries with high or low levels of corruption. The more equal the distribution of assets, the lower the impact of corruption on income distribution but the larger the negative impact of corruption on the growth rate of income. The study also finds that corruption affects the gini coefficient through government consumption. The authors, however, do not allow economic growth to influence the gini coefficient. Gupta et al. (2002) find that corruption increases income inequality in a sample of developing countries. They also find that increased corruption is associated with decreases in the share of government expenditures on education and health care. To the extent that the poor in LDCs rely on government educational programs to escape poverty and on government health care programs for improved health more than the rich, decreases in these expenditures decrease the welfare of the poor. Hendriks et al. (1998) and Johnston (1989) find that the distributional effects of corruption and tax evasion are regressive, hence increases income inequality.

None of the studies reviewed above investigates regional or country differences in the impact of corruption on economic growth and income distribution. While corruption may have a deleterious effect on economic growth and income distribution, the impact may be larger in some regions, especially in the low income regions of Sub-Saharan Africa, than in other parts of the world. While most studies treat corruption and other determinants of growth and income distribution as exogenous, we treat the growth rate of per capita income and corruption as jointly endogenous, and use an IV estimator to investigate the impact of corruption on income growth.

3. Model and estimation method

In this section, we present outlines of income growth and income inequality equations we estimate in section 4 of this paper. We also discuss the dynamic panel estimator used to estimate the income growth equation. The first subsection introduces the growth and inequality equations while the second subsection discusses the estimator we use.

3.1. Model

3.1.1. Income growth rate

The growth equation we estimate is a variant of the expanded neoclassical growth model that has been estimated by earlier researchers. Modern growth theory suggests that institutions are important determinants of income growth in an economy. We see corruption as an indicator of institutional failure and introduce this institutional failure variable into a standard Barro type growth equation, estimated by many researchers (Barro 1991; Caselli et al. 1996; Gyimah-Brempong and Traynor 1999; Gyimah-Brempong 2002; Levine and Renelt 1992; Mankiw et al. 1992; Sachs and Warner 1997). Although this is a long-run growth model, it can, and has been used to analyze *transition* growth (Caselli et al. 1996). This is the framework we adopt in this paper. Since this growth equation is well known, we do not spend time to develop

[3] In this paper, we use income distribution and income inequality interchangeably.

it but mention the outlines of the equation we estimate. The development economics literature suggests that corruption has a deleterious effect on economic growth through two main channels. It decreases growth directly by decreasing the productivity of existing resources through lower productive effort, non optimal input mix, or by diverting human capital to non-productive rent-seeking activities as indicated in section 2 above. Indirectly, corruption decreases economic growth through a reduction in investment in both physical and human capital (Wei 2000; Gupta et al. 2000; Mauro 1998; Tanzi and Davoodi 1997). Corruption has its own momentum; increased corruption decreases the marginal value of honesty, hence most human resources are channeled towards rent seeking activities.

In its simplest form, we postulate that the growth rate of per capita income depends on investment rate (k), initial level of income (y_0), growth rate of real export earnings ($\dot{x}$), and the stock of human capital which we proxy by the educational attainment of the adult population (edu). In addition to these variables, we include corruption ($corrupt$) to measure the quality of institutions in an economy. We assume that the nature of corruption is correlated with regional characteristics since these are likely to have evolved historically over time. To capture possible regional differences in the growth impact of corruption, we include three regional dummy variables – Africa ($africa$), Asia ($asia$), and Latin America ($latin$) · interacted with corruption as regressors. The comparison group is the group of countries in the sample that are members of OECD. The coefficients of the interaction terms measure the regional differences in the growth rate of income we investigate in this paper. We specify the growth equation in a linear form. The growth equation we estimate is given as:

$$\begin{aligned} \dot{y}_{it} &= \alpha_0 + \alpha_1 k_{it} + \alpha_2 edu_{it} + \alpha_3 \dot{x}_{\text{it}} + \alpha_4 corrupt_{it} + \alpha_5 y_{0,it} \\ &\quad + \alpha_j \sum_j dum_j \times corrupt_{it} + \epsilon, \qquad (1) \\ j &= africa, asia, latin, \end{aligned}$$

where $\dot{y}$ and $\dot{x}$ are the growth rates of real income and exports respectively, ϵ is a stochastic error term, α_is are coefficients to be estimated, and all other variables are as defined above in the text. We include the growth rate of exports as a regressor in the growth equation on the strength of the arguments made by Feder (1983) and Balassa (1978). In accordance with the economic growth literature, we expect the coefficients of k, edu and $\dot{x}$ to be positive, while corrupt is expected to have a negative coefficient. We expect the coefficient of y_0 to be negative if the convergence hypothesis holds for the countries in our sample.

In the growth equation presented above, we argue that corruption affects the growth of income in two possible ways. Directly, corruption can reduce income growth rate through a reduction in the productivity of existing resources. Indirectly, corruption can reduce the growth rate of income through reduction in the quality and quantity of investment in physical and human capital (Wei 2000; Mauro 1995). Corruption can also affect economic growth negatively through a destruction of economic and social institutions as well as through decreased technical progress. The total growth effect of corruption is therefore likely to be larger than the one estimated by the coefficient of corrupt in the growth equation.

3.1.2. Corruption and income inequality

Some researchers (Gupta et al. 2002; Li et al. 2000; Hendriks et al. 1998; Jain 2001; Johnston 1989) argue that corruption increases income inequality through several channels. First, it increases income inequality and poverty through decreased economic growth since the poor are the most likely to suffer during periods of economic stagnation. Second, corruption leads to a bias of the tax system in favor of the rich, thus making the *effective* tax system regressive. Corruption also lead to the concentration of assets among a few wealthy elite. Because earning power depends, to some extent, on resource endowment (including land and inherited wealth), the rich are able to use their wealth to further consolidate their economic and political power.

The provision of public services such as education and health care in LDCs is a way out of poverty for many people. Corruption, it is argued, decreases the quantity as well as the effectiveness of resources spent on social programs that benefit the poor. Even when resources spent on social programs are not reduced, corruption changes the distribution of this spending to benefit the rich at the expense of the poor (Gupta et al. 2000; Tanzi and Davoodi 1997). For example, health care expenditures may be tilted toward building "modern" hospitals that cater only to the rich at the expense of preventive health care that benefits the poor. In the same way, education spending could be skewed towards subsidizing higher education for the rich rather than towards primary and secondary education that benefit the poor. Another mechanism through which corruption can affect income distribution is the choice of development strategy. Fields (1980) argues that the choice of development strategy influences income inequality as labor intensive development strategy leads to equitable distribution of income while the opposite is true for a capital intensive development strategy. When corruption leads to subsidies on capital resulting in a capital intensive development strategy, income inequality increases.

In view of these considerations, we investigate the effects of corruption on income distribution by regressing the gini coefficient of income distribution ($gini$) on the growth rate of per capita income ($\dot{y}$), the level of per capita income (y), government consumption ($govcon$), education (edu), and corruption ($corrupt$). As in the income growth equation, we capture regional differences in income inequality by including the interaction of regional dummies with $corrupt$ as added regressors. The gini equation we estimate is:

$$\begin{aligned} gini &= \gamma_0 + \gamma_1 \dot{y} + \gamma_2 edu + \gamma_3 y + \gamma_4 corrupt \\ &\quad + \gamma_5 govcon + \gamma_j \sum_j dum_j \times corrupt + \xi, \qquad (2) \\ j &= africa, asia, \text{ and } latin \end{aligned}$$

where ξ is a stochastic error term, γ_is are coefficients to be estimated, and all other variables are as defined in the text. Consistent with the arguments above, we expect corruption to be positively correlated with the $gini$ coefficient.

3.2. Estimation method

We discuss the estimation methodology in this subsection. The first sub-subsection discusses the estimation method for the growth equation while the second sub-subsection briefly mentions the estimation method for the $gini$ equation.

3.2.1. Growth equation: the dynamic panel estimator (DPD98)

The growth equation is estimated with panel data from 61 countries between 1980 and 1998. In panel data estimation, neither the generalized least squares (GLS) estimator nor fixed effect (FE) estimator produces consistent estimates in the presence of dynamics and endogenous regressors. Growth equations have endogenous regressors as well as unobserved country fixed effects which are correlated with the regressors (Caselli et al. 1996) hence the orthogonality condition is not likely to be met for a GLS or FE estimator to produce consistent estimates. An IV estimator that accounts for correlated fixed effects and endogenous regressors is therefore needed.

Arellano and Bond (1991) have proposed a dynamic panel general method of moments (GMM) estimator that produces consistent estimates in the presence of dynamics and endogenous regressors. We use the dynamic panel (DPD) estimator partly because we do not have reasonable instruments for the endogenous regressors that can be excluded from the growth equation and partly because it produces consistent estimates in the presence of endogenous regressors. Arellano and Bond provide a family of dynamic panel GMM estimators in the DPD98 program that allows for one to estimate coefficients from levels, first difference, or orthogonal deviation of the variables.[4] In this study, we estimate the growth equation in levels, first difference, as well as in orthogonal deviation to ensure that our results are not dependent on the way we estimated the equation.

The DPD estimator is given as:

$$\hat{\boldsymbol{\theta}} = (\bar{\boldsymbol{X}}'\boldsymbol{Z}\boldsymbol{A}_N\boldsymbol{Z}'\bar{\boldsymbol{X}})^{-1}\bar{\boldsymbol{X}}'\boldsymbol{A}_N\boldsymbol{Z}'\bar{\boldsymbol{y}},$$

where $\hat{\theta}$ is a vector of coefficient estimates on both exogenous and endogenous regressors, $\bar{\boldsymbol{X}}$ and $\bar{\boldsymbol{y}}$ are the vectors of first differenced regressors and dependent variables, respectively, $\mathbf{Z}$ is a vector of instruments and $\mathbf{A_N}$ is a vector used to weight the instruments. The estimator uses all lagged values of endogenous and predetermined variables as well as current and lagged values of exogenous regressors as instruments in the differenced equation. For example, for the equation: $\Delta y_{i3} = \alpha\Delta y_{i2} + \beta\Delta x_{i3} + \Delta\zeta_{i3}$ we use y_{i1}, x_{i1} and x_{i2} as instruments. For the Δy_{i4} equation, $y_{i1}, y_{i2}, x_{i1}, x_{i2}$ and x_{i3} serve as valid instruments. Instruments for other cross sectional equations are constructed similarly. These instruments are correlated with the endogenous regressors but not correlated with the error terms, hence they are "good" instruments. The dynamic panel estimator is a GMM IV equivalent of an efficient three stage least squares (3SLS) estimator.

Arellano and Bond proposed two estimators – one- and two-step estimators – with the two-step estimator being the optimal estimator. The one-step estimator uses the weighting matrix given by $A_N = (N^{-1}\sum_i Z_i'HZ_i)^{-1}$ where H is $T-2$ square matrix with 2s in the main diagonal, -1s in the first subdiagonal, and 0s everywhere else. The optimal two-step estimator uses an estimated variance-covariance matrix formed from the residuals of a preliminary consistent estimate of $\hat{\theta}$ to weight the instruments. The optimal choice of $\mathbf{A_N}$ is: $A_N = \hat{V_N} = N^{-1}\sum_i Z_i'\hat{\hat{v_i}}\hat{\hat{v_i}}Z_i$ where $\hat{v_i}$ is the residual obtained from a preliminary consistent estimate of θ. We use the two step estimator to estimate the coefficients of the growth equation because it is more efficient than the one-step estimator.

In estimating the growth equation, we lag all variables by one period to ensure that y_{t-1} can be treated as exogenous in period t. We make two identifying assumptions of no autocorrelated errors and that the endogenous regressors are not considered predetermined for $v_{i,t}$ but are considered so for $v_{i,t+2}$. This allows us to use all values of x_t up to x_{t-1} as valid instruments for $\hat{x_t}$. The linear moment restriction implied by the model is $E[(\Delta\tilde{y}_{it} - \Delta\tilde{X}'_{i,t-1}\Theta)X_{i,t-j}] = 0$

[4] Orthogonal deviations expresses each observation as the deviation from the average of future observations in the sample for the same country, and weight these each deviation to standardize the variance. Formally, the orthogonal deviation of the variable x, (x^*_{it}) is given as:

$$x^*_{it} = \left(x_{it} - \frac{x_{i,t+1} + \cdots + x_{i,T}}{T-t}\right)\left(\frac{T-t}{T-t+1}\right)^{0.5} \qquad for \quad t = 1, \ldots, T-1$$

Arellano and Bond show that if the original errors are uncorrelated and homoskedastic, the transformed errors will also be uncorrelated and homoskedastic.

for $j = 2, ..., t - 1$, where $X' = (y_{t-1}, X)$ is the vector of lagged endogenous and strictly exogenous regressors. The consistency of the estimates hinges on the assumption of lack of autocorrelated error terms, hence we test for the absence of serial correlation of the error terms. We also perform Sargan test of over-identifying restrictions which is a joint test of model specification and appropriateness of the instrument vector. If all regressors are strictly exogenous, the DPD, RE, and FE estimators are consistent but only the latter two estimators are efficient. On the other hand, if there are endogenous regressors, the FE and RE estimators are inconsistent. We therefore use a Hausman test to test for the strict exogeneity of all regressors, hence the appropriateness of the DPD estimator used to estimate the model.

3.2.2. The gini equation

Previous research suggests that corruption is an endogenous variable. We therefore treat the growth rate of income and $corrupt$ as endogenous regressors in the $gini$ equation. However, in most cases, we have only a single cross-section data for the $gini$ equation, hence we cannot use the dynamic panel estimator to estimate the $gini$ equation. We therefore use the 2SLS estimator to estimate the $gini$ equation. In estimating the gini equation, we treat the data as a strictly cross-country sample.

4. Data

The dependent variables in our model are the growth rate of per capita real income ($\dot{y}$) and a measure of income inequality. We measure $\dot{y}$ as the annual growth rate of real per capita income in a country. There are several possible ways to measure income inequality, none of which is perfect. We measure income inequality by the gini coefficient of income distribution ($gini$) in a country. We chose $gini$ as our measure of income inequality because it is the most commonly available inequality index and also because it is easy to interpret.

The explanatory variables are investment (k), growth rate of real exports ($\dot{x}$), education (edu), corruption ($corrupt$), government consumption ($govcon$), per capita income (y), and initial income (y_0). Following earlier researchers (Barro 1991; Levine and Renelt 1992; Gyimah-Brempong 2002; Gyimah-Brempong and Traynor 1999), we measure k as the gross domestic investment/GDP ratio in a country. Measuring k this way allows us to control for the size of an economy, hence help to reduce heteroskedasticity. While some researchers use private investment on account of inefficiency of public investment (and because it may be influenced by corruption), we believe that public investment enhances the productivity of private investment. This "complementarity" in production implies that it is the total investment, rather than private investment, that should be included in the growth equation. Initial income (y_0) is measured as the real per capita GDP at the beginning of a period while y is measured as real per capita income in the current period. For example, for the 1980–1984 period, y_0 is measured as per capita income for 1980. $\dot{x}$ is measured as the growth rate of real export earnings in a country in a year while edu is the average years of education attained by the adult population (25 years and above) in a country in a year. This measure of education does not account for the *quality* or the *productivity* of education; it also does not consider whether educated people are productively employed or not. $govcon$ is measured as the ratio of government consumption to GDP in a country in a period.

Corruption ($corrupt$) is hard to measure and quantify. For one thing, what is a normally accepted practice in one country or time period in the same country may be considered a corrupt practice in another country or time period. Second, because corruption often involves illegal activities, most corrupt practices are hidden, hence not easily quantifiable. Instead the researcher observes the *perception* of corruption. We use the perception of corruption indices published by Transparency International (TI) and University of Gottingen as our measure of corruption. The index is an average of different surveys of *perceptions* of corruption in a country. The index is ranked from 0 to 10 with 10 being the least corrupt and 0 the most corrupt.

While the TI data is widely used, it has its disadvantages. For one thing, it is based on a survey of *perceived* corruption. What may be perceived as a corrupt practice to a Western visitor to an African or Asian country may be gift giving in the African or Asian context. Second, the index says nothing about the degree to which corruption affects resource allocation, hence efficiency. Decentralized and uncoordinated or "degenerative" corruption may have a growth effect that is different from that of centralized and coordinated or "developmental" corruption. On the other hand, if a large number of surveys agree that corruption is high and pervasive in a particular country, one has to put some credence in this index. The TI data have been published for all the countries in our sample since 1994. For some countries in the sample, TI did not report *annual* data before 1994. Fortunately TI publishes historical data representing the average index of corruption between 1981 and 1985, 1987–1990, and 1991–1994. We proxied $corrupt$ with these historical values where annual data on $corrupt$ was not available. Our results should therefore be interpreted with these data problems in mind.

In addition to TI's corruption perception index, we use two alternative corruption indices calculated by Mauro (1995) – Business International's (BI) index of corruption and bureaucratic efficiency (*efficiency*) – from Business International to investigate the robustness of our estimates. The BI index is calculated from a survey of businesses' perception of corruption in a country and ranges from 1 to 10 with 1 being the most corrupt while 10 is the least corrupt country. Mauro (1995) also calculated a broader index of corruption (*efficiency*), which averages the BI index of corruption, index of red tape, and an index of efficiency of the legal system. The data for BI and *efficiency* were obtained from Mauro (1995). Data for $\dot{y}$, y_0, k, $govcon$, and $\dot{x}$ were obtained from the World Bank's *World Development Indicators*, (World Bank, Washington, DC, USA, 2000). Data for edu was obtained from Barro and Lee (2000) and updated with data from the World Bank's *World Development Report, 1999/2000*. Data for $gini$ were obtained from Deininger and Squire (1996) and supplemented with data from World Bank's *World Development Indicators, 2000*. All nominal variables were converted to real equivalents with 1987 as the base year.

The data are annual observations for a sample of 61 countries for the 1980–1998 period.[5] Fourteen of the countries are from Africa, 15 from Asia, 11 from Latin America and 21 are from OECD countries. We follow the usual practice in cross-country regression research and take 5 year averages of the variables in order to reduce the noise in the annual data. Taking 5 year averages gives us four observations for each country, giving us a total of 244 observations for our regression analysis. For the income inequality equation, we had 164 observations because not all countries had income inequality data for all years and some countries did not

[5] The countries in the sample are: Argentina, Australia, Austria, Belgium, Bolivia, Brazil, Bulgaria, Cameroon, Canada, Chile, China, Colombia, Cote d'Ivoire, Denmark, Equador, Egypt, El Salvador, Finland, France, Ghana, Greece, Hong Kong, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Jordan, Kenya, Korea, Luxembourg, Malawi, Malaysia, Mauritius, Mexico, Morocco, Namibia, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Peru, Philippines, Poland, Portugal, Senegal, Spain, Sweden, Switzerland, Thailand, Tunisia, United Kingdom, United States, Uruguay, Venezuela, Zambia, and Zimbabwe. Countries contained in the sample was dictated by data availability, especially data on corruption.

Table 1 Summary statistics of sample data

Variable	Label	Mean[a]	Std. Err.	Min.	Max.
Growth	$\dot{y}$ (%)	1.9038	2.3715	−5.7033	9.0192
GDP per capita	y (87 PPP$)	8257.85	6863.10	352.94	27459.30
Corruption	*corrupt*	5.1567	2.5624	0.2800	9.5500
Invesment/GDP	k (%)	22.1031	5.7757	9.2246	40.9958
Priv. inv/GDP	k_p (%)	9.9714	30.9441	0.0022	49.8338
Export Growth	$\dot{x}$ (%)	6.9335	4.7755	−13.8739	21.3539
Education	*edu*	5.3492	1.6665	1.8200	12.0100
Income Ineq.	*gini*	0.3832	0.0937	0.2097	0.6200
Mauro Corup. 1	*BI*	7.1328	2.6076	0.20	10.00
Mauro Corup. 2	*efficiency*	6.9065	2.4203	0.2776	10.00
Gov. Cons.	*govcon* (%)	16.28	11.26	7.00	38.14
Etho. ling. frac.	*ELF* (%)	33.3114	29.2194	1.00	89.00
Polit. inst.	*PI*	0.2134	0.0862	−0.5138	0.7814
$N = 244$					

[a] These are unweighted averages

have any observations at all for income distribution and were therefore excluded from the *gini* equation.[6] For the *BI* and *efficiency* data set, we only had observations averaged over the 1980–1983 period. We therefore merged that data set with observations for the first period (1980–1984) of our larger data set for that part of the analysis. Merging the two data sets gave us a sub-sample with 48 usable observations.[7] With the exception of *PI*, we log transform all variables in estimating the growth equation, allowing us to interpret the coefficient estimates as elasticities.[8]

Summary statistics of the data are presented in Table 1. The summary statistics indicate that growth rate, investment, per capita income, and other variables vary greatly across countries in our sample. There is a wide variation in the corruption index with *corrupt* ranging from a low of 0.25 for Nigeria in 1 year to a high of 9.6 for Iceland. The sample therefore includes countries that are perceived to be highly corrupt as well as those that are perceived to be highly honest. All three indices of corruption average about 5 with a standard deviation of about 2.5. The Pearson correlation coefficients between *corrupt* and *BI*, *corrupt* and *efficiency*, and *BI* and *efficiency* are 0.89, 0.87, and 0.93 respectively, indicating a high degree of correlation among the three measures of corruption. *BI* and *efficiency*, similarly, show wide variations across countries in our sample.

[6] We note that the reliability of the *gini* data varies across countries as Deininger and Squire cautions. Readers should therefore treat our results as indicative rather than definitive. For the *gini* equation, we had no data for Iceland, Jordan, and Namibia and were therefore excluded from the sample. Other countries did not have data for all four periods so we had a total of 164 observations.

[7] Countries in this sample are: Argentina, Australia, Austria, Belgium, Brazil, Cameroon, Canada, Chile, China, Colombia, Cote d'Ivoire, Denmark, Equador, Egypt, Finland, France, Ghana, Greece, Hong Kong, Iceland, India, Ireland, Israel, Italy, Japan, Jordan, Kenya, Korea, Malaysia, Mauritius, Morocco, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Peru, Philippines, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States of America, Uruguay, Venezuela, and Zimbabwe.

[8] To ensure that we do not take the logs of negative numbers, we added 6 and 14 to $\dot{y}$ and $\dot{x}$ respectively before taking the logs of these variables.

Table 2 Two-step coefficient estimates of growth equation

Variable		Coefficient	Estimates	
	Levels	First Dif.	Orthog. dev.	First Dif.
k	0.1486	0.1539	0.1487	–
	(4.2456)[a]	(3.9617)	(4.2703)	
k_p	–	–	–	0.1923
				(5.01289)
$corrupt$	0.1686	0.1751	0.1682	0.1823
	(5.4428)	(5.6841)	(5.4218)	(5.4214)
edu	0.2193	0.2438	0.2187	0.2217
	(2.5622)	(2.2592)	(2.5622)	(2.6829)
$\dot{x}$	0.1234	0.1422	0.1233	0.1318
	(3.6287)	(4.3563)	(3.6279)	(4.0181)
y_0	−0.0162	−0.0077	−0.0167	−0.0028
	(5.5198)	(5.7002)	(5.4679)	(6.1243)
$Time$	0.3127	0.3839	0.3128	0.2876
	(0.7119)	(0.7025)	(0.8319)	(1.0041)
$afric \times corrupt$	0.1168	0.1241	0.1168	0.1289
	(2.2873)	(2.2689)	(2.2874)	(30142)
$asia \times corrupt$	0.0289	0.0287	0.0288	0.0179
	(1.3897)	(0.8887)	(0.8921)	(0.7891)
$latin \times corrupt$	0.0823	0.0985	0.0836	0.0689
	(1.7978)	(1.8316)	(1.7997)	(2.1113)
N	244	244	244	228
1st. order ser. cor.	−0.883 [61]	−1.089 [61]	−0.9271 [61]	−0.6167 [61]
Jt. test of Sign.	73.8036 [9]	76.6358 [9]	73.8035 [9]	78.1393 [9]
Jt. sig. time dum.	1.5971 [2]	1.4182 [2]	1.2897 [2]	1.1181 [2]
Sargan Test	4.0918 [10]	3.6104 [10]	3.5718 [10]	3.8161 [10]
Hausman m	102.4189 [9]	86.2897 [9]	103.8192 [9]	121.8246 [9]

[a] Absolute value of asymptotic "t" statistics in parentheses

5. Results

This section presents and discusses the coefficient estimates of income growth and income inequality equations. The first subsection discusses the estimates of the income growth equation while the second subsection discusses the estimates for the $gini$ equation. We follow the discussion of the coefficient estimates of the growth equation with a discussion of an indirect channel through which corruption affects economic growth. We then report a number of robustness tests before going on to discuss the estimates for the $gini$ equation in the second subsection.

5.1. Income growth equation

5.1.1. Coefficient estimates

DPD coefficient estimates of the income growth equation are presented in Table 2.[9] Column 2 presents the levels estimates, column 3 the first difference estimates, while column 4 presents the orthogonal deviation estimates. Regression statistics presented in Table 2 indicate that the

[9] Estimates based on the one-step estimator produced estimates that are *qualitatively* similar to the two-step estimates presented here.

model fits the data relatively well. The test statistics indicate no first order serial correlation and the Sargan test statistics of model specification and over-identifying restrictions indicate that the equation is correctly specified with the appropriate instrument vector. The joint test of significance statistic rejects the null hypothesis that all slope coefficients are jointly equal to zero at any reasonable level of confidence. The Hausman test statistic leads to a rejection of the null hypothesis that all regressors in the growth equation are strictly exogenous. This indicates that the DPD estimator is the appropriate estimator to be used to estimate the growth equation.

The coefficient of k in Table 2 is positive and significantly different from zero at 1% significance level in all specifications indicating that, all things equal, high investment/GDP ratio is positively correlated with faster income growth. This result is similar to the results obtained by earlier researches (Barro 1991; Levine and Renelt 1991; Mankiw et al. 1992; Caselli et al. 1996; among others). The coefficient of $\dot{x}$ is positive, relatively large, and significantly different from zero at $\alpha = 0.01$ in all the three specifications. This result is consistent with the result of earlier research (Feder 1983; Balassa 1978). edu has a positive and statistically significant coefficient, a result that is consistent with the notion that human capital is an important determinant of economic growth of countries (Barro 1991; Barro and Lee 1997; Mankiw et al. 1992; Sachs and Warner 1997; Gyimah-Brempong 2002). The coefficient of y_0 is negative and significant, indicating the presence of conditional convergence in our sample. The coefficient of $Time$ is positive but insignificant in all specifications.

The coefficient of $corrupt$ in columns 2–4 in Table 2 is positive and significantly different from zero at $\alpha = 0.01$. The estimate of $corrupt$ suggests that corruption negatively affects the growth rate of income. The estimates suggest that a 10% increase in corruption decreases the growth rate of per capita income by about 1.7% – a relatively large effect given that the average growth rate of per capita income in the sample is 1.9%. [10] This growth effect is remarkably consistent across all three estimates. Thus decreasing corruption will have enormous impact on the growth rate of incomes of most countries, especially in slow growth countries of Sub-Saharan Africa. This result is similar to the results obtained by earlier researchers (Mauro 1995, 1998; Rose-Ackerman 1999; Shleifer and Vishny 1993; Wei 2000; Tanzi and Davoodi 1997; Barreto 2000; Mo 2001; Gyimah-Brempong 2002).

Are there regional differences in the growth impact of corruption? The answer depends on the coefficient estimates of the dummy interaction terms. The coefficient of $africa \times corrupt$ is positive and significantly different from zero at $\alpha = 0.05$ in all specifications, suggesting that the growth impact of corruption in African countries is higher than the growth impact of corruption in OECD countries. The coefficient estimates suggest that a 10% increase in corruption decreases the average growth rate of income in African countries by 2.8% compared to 1.7% in OECD countries. The coefficient of $latin \times corrupt$ is positive and significant at $\alpha = 0.05$, indicating that the growth effect of corruption is larger in Latin American countries than in OECD countries. A 10% increase in corruption decreases income growth rate in Latin American countries by 2.6% compared to 1.7% for OECD countries. The coefficient of $asia \times corrupt$ is positive but statistically insignificant at $\alpha = 0.10$ suggesting that the growth impact of corruption in Asian countries is not different from that of OECD countries.

The estimates indicate that there are large regional differences in the growth effects of corruption. Likelihood ratio test to test the null hypothesis that all three coefficients of the regional interaction terms are jointly equal to zero produced χ^2 statistics of 83.6808, 88.786,

[10] Because the index is measured in such a way that higher scores imply low levels of corruption, the positive coefficient implies that corruption has a large, significantly negative effect on the growth rate of per capita income.

and 79.5689 for the levels, first difference, and orthogonal deviation regression, respectively. We therefore reject the null hypothesis of no regional differences in the growth impact of corruption. These regional differences may be either due to differences in the nature of corrupt practices or due to differences in the sizes of the economies or both. It is possible that because African and Latin American economies are relatively small, corruption has relatively large negative effects compared to its negative effects on the larger economies of OECD and Asia. It is also possible that the nature of corruption in African and Latin American countries is more injurious to growth than the type of corruption found in OECD and Asian countries.

5.1.2. Transmission mechanism

The results indicate that corruption has a negative and statistically significant impact on the growth rate of per capita income. More important to our study, the results indicate that there are significant regional differences in the impact of corruption on economic growth. The result does not indicate the mechanism(s) through which corruption affect income growth and through which mechanism(s) the estimated regional differences manifest themselves. There are several possible mechanisms through which these effects could occur; among them, reduced resource mobilization. Several authors have argued that corruption reduces investment in physical and human capital (Wei 2000; Gupta et al. 2002; Tanzi and Davoodi 1997; among others). Other authors argue that corruption destroys or renders institutions (such as property rights laws, proper functioning of markets) ineffective in providing an environment in which to conduct business, hence leading to economic stagnation (Rose-Ackerman 1999; Mo 2001; Hellman et al. 2000; Hendriks et al. 1998; Ehrlich and Lui 1999; Lambsdorff 2001). The differential growth impact of corruption we have estimated could be partly due to differential impacts of corruption on investment in physical capital.

We investigate this physical capital investment mechanism by estimating a rudimentary accelerator model of investment with corruption as an added regressor. We regress investment rate (k) on the growth rate of per capita income ($\dot{y}$), real per capita income (y), corruption, government consumption ($govcon$), $Time$ and the interaction between corruption and the three regional dummies. While the accelerator model may be more appropriate for private investment, we nevertheless use it here because, where available, there is a high correlation between total and private investment in our sample. Besides, Barro (1991) shows that the same set of variables that explain private investment also explain total investment equally well. The investment equation we estimate is given as:

$$\begin{aligned} k_{it} &= \gamma_0 + \gamma_1 \dot{y}_{it} + \gamma_2 corrupt_{it} + \gamma_3 govcon_{it} + \gamma_4 y_{it} + \gamma_5 Time_t \\ &\quad + \gamma_6 \sum_j dum_j \times corrupt_{it} + \mu, \qquad (3) \\ j &= africa, asia, latin \end{aligned}$$

where μ is a stochastic error term and all other variables are as defined in the text. As in the growth equation, OECD countries are the basis for comparison. We used the DPD estimator to estimate the investment equation. The two-step DPD coefficient estimates of the investment equation are presented in Table 3. Column 2 presents the levels equation, column 3 the first difference equation, while column 4 presents the estimates for the orthogonal deviation equation. Regression statistics indicate that the simple accelerator investment equation fits the data reasonably well. In particular, the regression statistics indicate the absence of first-order autocorrelation, and the model is well specified as indicated by the Sargan test statistic. The Hausman exogeneity test statistic also suggests that the DPD estimator is the appropriate estimator to use for this investment equation.

Table 3 Two-step coefficient estimates of investment equation

Variable		Coefficient	Estimates	
	Levels	First dif.	Ortho. dev.	First dif. (k_p)
$corrupt$	0.2119	0.2229	0.2219	0.2346
	(2.7876)*	(3.2198)	(2.7868)	(4.2891)
$\dot{y}$	0.4608	0.4289	0.4608	0.4106
	(2.6198)	(2.6195)	(2.6178)	(2.1871)
y	0.2081	0.2638	0.2082	0.1187
	(5.5249)	(5.3073)	(5.5249)	(3.8972)
$govcon$	−0.1221	−0.2014	−0.1221	−0.2896
	(2.3892)	(2.6840)	(2.3891)	(3.1456)
$Time$	0.1227	0.2126	0.1227	0.1816
	(6.1677)	(5.9026)	(6.6316)	(6.2161)
$afri \times corrupt$	0.1091	0.1291	0.1091	0.1041
	(2.6312)	(1.9540)	(2.6316)	(2.8913)
$asia \times corrupt$	0.0189	−0.0612	0.0844	0.0078
	(0.8932)	(1.0261)	(0.8287)	(1.0091)
$latin \times corrupt$	0.0920	0.0862	0.0943	0.0821
	(1.6318)	(1.5560)	(1.6414)	(1.6188)
N	244	244	244	228
1st order ser. cor.	0.983 [61]	0.810 [61]	0.933 [61]	0.826 [61]
Jt. test of Sig.	69.108 [8]	369.4366 [8]	69.1081 [8]	321.433 [8]
Jt-jg sig. of time dum.	38.0388 [1]	108.0707 [2]	118.2035 [2]	101.211 [2]
Sargan Test	6.0218 [10]	3.9938 [10]	5.0210 [10]	3.4131 [10]
Hausman m	78.4121 [8]	89.2181 [8]	88.3382 [8]	83.1141 [8]

* Absolute value of asymptotic "t" statistics in parentheses.

The coefficients of $\dot{y}$ and y are positive, relatively large, and significantly different from zero at $\alpha = 0.05$ in all three specifications. This result confirms the accelerator hypothesis for this sample. Secondly, it suggests that investment rate is positively correlated with the level of per capita income in this sample. The coefficient of $govcon$ is negative and significantly different from zero at $\alpha = 0.05$ in all three specifications, confirming the crowding out hypothesis. The coefficient of $Time$ is positive, relatively large, and significant in all three specifications.

The coefficient of $corrupt$ is positive, relatively large, and significantly different from zero at $\alpha = 0.05$ in all three specifications. The estimated coefficient of $corrupt$ indicates that honesty increases the rate of capital formation, a result that is consistent with earlier findings (Wei 2000; Tanzi and Davoodi 1997; Mauro 1995; Del Monte and Papagni 2001; Gyimah-Brempong 2002). Given the positive correlation between income growth and investment, corruption decreases income growth rate indirectly through reduced investment. Moreover, since the coefficients of $corrupt$ and k in the growth equation are significant when both are included as regressors, this indirect growth effect is independent of corruption's direct negative growth impact. It is therefore important that researchers account for both direct and indirect effects of corruption on the growth rate of per capita income.

The coefficients of $africa \times corrupt$ and $latin \times corrupt$ are positive and significantly different from zero at $\alpha = 0.10$ while that of $asia \times corrupt$ is insignificant. This indicates that while corruption has additional negative effects on investment in Africa and Latin America countries over and above those of OECD countries, it does not have such an effect in Asian countries. The estimates in Table 3 suggest that one mechanism through which corruption differentially affects growth in African and Latin American countries is through differential impacts on physical capital investment. We note that the insignificant coefficient of $asia \times corrupt$ in Table 3 is consistent with and reinforces the insignificance of its counterpart in Table 2.

We have measured investment as gross fixed investment/GDP ratio. This includes both private and public investment. Gupta et al. (2000) and Tanzi and Davoodi (1997) argue that corruption leads to an increase in public investment projects which may be wasteful hence have little or no growth impact. This means that corruption may have differential growth impacts through private and public investments. It may therefore be necessary to distinguish between private and total investment in the growth process. We investigate this by estimating the growth and investment equations using private investment/GDP ratio (k_p) as an alternative measure of investment. There are a few countries in the sample for which we could not get data on private investment for all periods. We therefore have a sample of 228 observations for this regression.[11]

The estimates are presented in column 5 of Tables 2 and 3. For space considerations, we only present the coefficients for the first difference estimator for this equation. The regression statistics show that the model fits the data reasonably well. The estimates of the growth equation shown in column 5 of Table 2 are remarkably similar to their counterparts in column 3 where we measure investment as Gross investment/GDP ratio. In particular, the coefficient of k_p and $corrupt$ are positive, relatively large, and significantly different from zero at $\alpha = 0.01$. However, the coefficient of k_p is larger, in absolute magnitude than that of k, shown in column. This suggests that the growth effects of private investment may be much larger than the growth effect of public investment. The regional interaction terms are also positive and significantly different from zero (Asia is the only exception). Finally, measuring investment as private investment/GDP ratio has no qualitative impact on the coefficient estimates of other variables in the growth equation. We conclude from this that the regional differences in the growth impact of corruption we find in this paper does not depend on how we measure corruption.

The estimates of the k_p equation, presented in column 5 of Table 3, fits the data reasonably well as shown by the regression statistics. All coefficients have the expected signs and are significantly different from zero at traditional significance levels. In particular, the coefficient of $corrupt$ is positive, relatively large, and significantly different from zero at $\alpha = 0.01$. The coefficient of $corrupt$ in column 5 is larger in absolute magnitude than its counterpart in column 3, suggesting that corruption has a much more deleterious impact on private investment than on public investment. The coefficient of the regional interaction terms in column 5, as with their counterparts in column 3, are positive, and with the exception of the Asian interaction term, are significantly different from zero at $\alpha = 0.10$ or better. From the estimates in column 5 of Table 3, we conclude that our result that corruption has a differential effect on investment in Africa and Latin America relative to OECD and Asian countries does not depend on the way we measure investment. Our results, however, suggest that corruption has relatively stronger impacts on private investment, hence growth than on public investment.

5.1.3. Robust tests

It is possible that our results depend on omitted variable bias, or on the sample used to estimate the growth equation. In this subsection, we investigate the robustness of our estimates. We begin by adding additional explanatory variables, one at a time, to the growth equation

[11] Data for k_p were obtained from the World Bank's *World Development Indicators, 2002*, (World Bank, Washington, DC, USA).

Table 4 Robust tests

Panel A: Additional regressors				
Variable	Equator	Gov	PI	
corrupt	0.1202	0.1379	0.1204	
	(2.3658)*	(2.5099)	(2.3881)	
africa × *corrupt*	0.2193	0.2487	0.1901	
	(2.4521)	(3.3176)	(2.4152)	
asia × *corrupt*	0.0897	0.1818	0.0897	
	(0.8978)	(0.9872)	(0.8980)	
latin × *corrupt*	0.1019	0.1052	0.1041	
	(1.7311)	(1.8528)	(1.7228)	
N	244	244	244	
Panel B: Different samples				
Variable	Excl. Africa	Excl. OECD	High Corrupt.	Low Corrupt.
corrupt	0.2452	0.2879	0.2891	0.2209
	(2.4639)	(2.8312)	(2.3301)	(2.5693)
africa × *corrupt*		0.3462	0.3526	0.2325
		(2.1048)	(2.4162)	(1.9982)
asia × *corrupt*	0.0412		0.1001	0.2123
	(1.0413)		(0.2164)	(0.8928)
latin × *corrupt*	0.1165	0.1117	0.2141	0.1899
	(1.9162)	(1.8886)	(1.6994)	(1.8193)
N	200	160	124	120

* Absolute value of asymptotic "t" statistics in parentheses

to see if this significantly changes our results. We then estimate the growth equation using sub-samples of the data to see if our results are driven by a subset of the sample used to estimate the equation.

5.1.3.1 Additional explanatory variables Sachs and Warner (1997) argue that geography has an effect on the growth rate of income as tropical countries tend to grow slower than non tropical countries. Excluding this variable from the growth equation could, potentially, lead to biased estimates of the effects of corruption on income growth. We therefore use distance from the equator (*equator*) as an additional variable in the growth equation. This variable is usually scaled to range between 0 and 1. We follow this convention. The data for *equator* was obtained from La Porta, R., F. Lopez-de-Silanas, A. Shleifer, and R. Vishny (1999), "The Quality of Governments", *Journal of Law, Economics, and Organization*, **15**, 222–279. Several authors have argued that increased government consumption decreases economic growth (Barro 1991; Mankiw et al. 1992; Del Monte and Papagni 2001; Ehrlich and Lui 1999; Gray and Kaufmann 1998; Mauro 1995). The second additional variable we use therefore is government consumption/GDP ratio (*govcon*). Finally, several authors find that political instability has a negative effect on the growth rate of income (Barro 1991; Knack and Keefer 1995; Gyimah-Brempong and Traynor 1999). We therefore use political instability (PI) as an added regressor in the growth equation. We measure PI as in Gyimah-Brempong and Traynor (1999). Data for the calculation of PI were obtained from A. Banks (1995), *Cross-National Time-Series Data Archive*, Center for Social Analysis, State University of New York at Binghampton, Binghampton, New York.

Results of this exercise are presented in panel A of Table 4. Columns 2, 3, and 4 present the coefficient estimate of *corrupt* when *equator*, *govcon*, and PI respectively, are included as additional regressors.[12] The coefficient of *corrupt* presented in panel A of Table 4 is positive and significantly different from zero at $\alpha = 0.05$ regardless of the additional variable we include in the growth equation. The coefficients of the dummy interaction terms for Africa and Latin America are positive and significantly different from zero while that of $asia \times corrupt$ is insignificant. The inclusion of the additional variables does not affect the precision of the estimate of *corrupt*. More important, the structure of the regional difference estimates are remarkably stable regardless of which variables we add to the growth equation. These coefficient estimates suggest that the regional variables are not acting as proxies for some omitted variables which should be included in the global growth equation.

5.1.3.2 Subsamples It is possible that our results depend on the inclusion of some countries. For example, Sub-Saharan Africa countries combine slow growth with high corruption while OECD countries are generally perceived to be less corrupt and have had respectable rates of income growth over the sample period. To see whether our results are driven by the sample of countries used, we estimate the growth equation for a sample that excludes African countries, and one that excludes OECD countries. Where the sample excludes OECD countries, the comparison group is the group of Asian countries in the sample. The estimates for these sub-samples are presented in columns 2 and 3 of panel B in Table 4. It is possible that corruption affects economic growth differently when it becomes endemic in a country than in countries where corruption is not entrenched. We therefore split the sample into high and low corruption countries and estimate the growth equation for these two sub-samples. We classify a country as a high corruption country if its corruption perception index is 5 or less and as a low corruption country if its corruption perception index is greater than 5. Columns 4 and 5 of panel B of Table 4 present the estimates for the high and low corrupt sub-samples respectively.

In all four sub-samples, the coefficient of *corrupt* is positive and significantly different from zero at $\alpha = 0.05$. The regional interaction terms have positive coefficients and, with the exception of Asia, are significant at $\alpha = 0.10$. In all four sub-samples, we reject the null hypothesis that the coefficients of the regional interaction terms are jointly equal to zero at $\alpha = 0.05$. The implication of this exercise is that the regional differences in the impact of corruption on growth is robust to different specifications and sample selection.

5.1.3.3 Alternative measures of corruption Our results are based on TI corruption index. It is possible that our results are driven by this measure of corruption. To investigate this possibility, we use two alternative measures of corruption – BI and *efficiency* – to investigate regional differences in the growth impact of corruption. The data for BI and *efficiency* are for the 1980–1983 period. We are therefore not able to use the DPD estimator to estimate the growth equation. Instead, we estimate the growth equation with cross-national data that averages the variables over the 1980–1983 period.

It is possible that both BI and *efficiency* are correlated with the error term, hence OLS estimates may not be appropriate. We follow Mauro (1995) and use ethno-linguistic fractionalization index (ELF) as an instrument for both measures of corruption. ELF is defined as the probability that two randomly selected individuals in a country belong to different ethno-linguistic groups and ranges from 0 to 1 with 1 being the most ethnically fractured society and 0 the most ethnically homogenous country. The data for ELF were obtained from Mauro (1995). The R^2 for the first stage regressions are 0.59 and 0.63 for BI and *efficiency*

[12] In this section, we do not present the full set of estimates but only the estimates of *corrupt* and its interaction terms in order to conserve space. We also present only the estimate from the difference equation.

Table 5 Estimates of growth equation: alternative corruption indices

Variable		Coefficient	Estimates		
k		0.1279		0.1026	–
		(2.8795)[a]		(2.5457)	
k_p					0.1784
					(3.1249)
BI	0.2986	0.1492			0.1318
	(2.1872)	(2.6239)			(2.7182)
efficiency			0.5219	0.4626	
			(2.8482)	(2.9812)	
edu		0.1389		0.1893	0.1249
		(1.6835)		(1.8610)	(1.9264)
$\dot{x}$		0.2433		0.2572	0.2516
		(3.9820)		(3.2187)	(4.1261)
y_0		−0.0001		−0.0001	−0.0001
		(2.1271)		(1.7710)	(2.1372)
$afric \times corrupt$		0.3321		0.3823	0.3886
		(2.8747)		(2.6813)	(2.9642)
$asia \times corrupt$		0.0461		0.0254	0.0321
		(0.3897		(0.2986)	(0.1892)
$latin \times corrupt$		0.2896		0.3189	0.2694
		(2.5569)		(2.4298)	(2.8882)
N	48	48	48	48	48
$\bar{R}^2$	0.1589	0.4871	0.1206	0.5132	0.5286
F	8.4270	21.4289	8.0121	22.5821	24.4892

[a] Absolute value of "t" statistics in parentheses

respectively, indicating a high degree of correlation between ELF on the one hand and BI and *efficiency* on the other. The high R^2 confirms that ELF is a "good" instrument for BI and *efficiency*. The results of the IV estimates using BI and *efficiency* as our measures of corruption are presented in Table 5. Columns 2 and 3 present the estimates when BI is used as the index of corruption while columns 4 and 5 present the estimates when *efficiency* is the index of corruption. To test whether our results depend on the measure of investment we use, we also present the BI estimates in which we measure investment as private investment/GDP ratio in column 6 of Table 5. The regression statistics indicate that the equation fits the data relatively well.

The coefficient of BI in column 2 is positive and significantly different from zero at $\alpha = 0.05$, suggesting that corruption, when proxied by BI, has a significantly negative effect on the growth rate of per capita income. The estimates in column 3 add additional regressors to the BI index of corruption. The coefficient of BI in column 3 is positive and significantly different from zero at $\alpha = 0.05$ as in column 2. Inclusion of the other regressors do not affect the statistical significance of the estimate of BI, although the absolute magnitude of the coefficient decreases. Moreover, the coefficient of the additional regressors are of the expected signs and are significantly different from zero at $\alpha = 0.05$. The coefficient of *efficiency* in column 4 is positive, relatively large, and significantly different from zero at $\alpha = 0.10$, suggesting that an increase in honesty (decrease in corruption) increases the growth rate of per capita income. Adding more regressors to *efficiency* in column 5 does not change the sign, magnitude, or the precision of the coefficient of *efficiency*. Moreover, the coefficients of the other variables are of the expected signs and precisely estimated.

The coefficient of the African and Latin American interaction terms with BI and *efficiency* in columns 3 and 5 are positive and significantly different from zero at $\alpha = 0.01$. The coefficient of the Asian dummy interaction term is insignificant. An F test to test the null hypothesis that the coefficients of all the regional interaction terms with $corrupt$ are jointly equal to zero produced F statistics of 8.3168 and 8.9874 for BI and *efficiency*, respectively. With 3 and 37 degrees of freedom, we reject the null at $\alpha = 0.01$. The estimates suggest that there are statistically significant regional differences in the effects of corruption on the growth of income. This suggests that the regional differences in the growth effects of BI and *efficiency* we find in this section are similar to the regional differences in the growth impact of corruption we found above and are not driven by the TI index of corruption we use. Regardless of the measure of corruption we use, the negative growth impact of corruption is largest in Africa, followed by Latin America and Asia and OECD countries respectively.

In column 6, the coefficient of k_p is positive and significantly different from zero in the statistical sense. Its magnitude is just as large as its counterpart (k) in column 3. The coefficients of all the other variables in column 6 have the expected signs and are significantly different from zero, just as their counterparts in column 3. In particular, the coefficients of the interaction terms are also positive, and with the exception of the Asia interaction term, are significantly different from zero at $\alpha = 0.10$ or better. In addition, the magnitudes of these coefficient estimates are not different from their counterpart in column 3. This suggests that whether we measure investment as total investment or private investment, corruption does have a negative growth impact, partly through reduced investment and there are also regional differences in these impacts.

What policy implications can be drawn from our results? Almost all countries aspire to faster economic growth. Often, low income countries look to FDI to generate the desired income growth. Our results indicate that corruption directly decreases the growth rate of per capita income. In addition, other researchers (Wei 2000) find that corruption decreases FDI as well as investment in public infrastructure (Del Monte and Papagni 2001). Some researchers find that corruption leads to political instability which in turn has a negative effect on economic growth (Mo 2001). This means that highly corrupt countries cannot expect large inflows of FDI, increased domestic investment, or a stable political environment, all necessary conditions for fast growth rate of income. The implication of our results is that high corruption countries can increase the growth rate of income by taking steps to reduce corruption.

The growth impact of corruption is not uniform across all regions of the world. This means that while it may be necessary to decrease corruption throughout the world to spur faster economic growth, this may not be equally pressing in all regions of the world. The need to reduce corruption as a means to spur economic growth and improve income distribution is more pressing in Africa and Latin America than it is in Asian and OECD countries. It is possible that it is not so much the *level* as much as the *type* of corruption in a region that affects economic growth. If this is the case, then African and Latin American countries could institute reforms to reduce the growth inhibiting aspects of corruption without necessarily eliminating corruption. Because reducing corruption may involve institutional reforms to make the resulting increased growth sustainable, the need for institutional reforms in African and Latin American countries may be more pressing than elsewhere. Since corruption has the largest growth effects in low income countries, decreasing corruption in those countries may also help to narrow the income gap between rich and poor countries.

Our results also suggest that the growth impact of corruption partly depends on the nature of corruption: whether it is of the "degenerative" variety or the "developmental" variety. "Degenerative" corruption as practiced in Africa and Latin America, has more deleterious effect on income growth and distribution as compared to the less destructive "developmental"

Table 6 Estimates of gini coefficient equation

Variable	Coefficient	Estimate	
$\dot{y}$		−0.4518	−0.3384
		(8.0316)*	(6.1589)
corrupt	−1.2242	−0.8359	−0.5802
	(4.4917)*	(2.9723)	(2.4907)
edu		−1.1497	−0.4142
		(2.7283)	(2.220)
govcon		0.4589	0.4361
		(3.2164)	(2.9913)
$africa \times corrupt$			−2.0924
			(4.4710)
$asia \times corrupt$			−0.9119
			(2.8200)
$latin \times corrupt$			−2.9133
			(8.3061)
N	164	164	164
F	20.17	14.401	20.918
$\bar{R}^2$	0.1107	0.2897	0.4846

* Absolute value of ‘t’ statistics in parenthesis

corruption practiced in Asia. However, as Wedeman (2002) points out, all types of corruption ultimately lead to lower economic growth as any “beneficial” effects of “developmental” corruption are likely to be overwhelmed by its negative effects in the medium to long run. This implies that regardless of whether corruption is “developmental” or “degenerative”, nations will have to take steps to reduce it in order to ensure sustained economic growth.

5.2. Corruption and income inequality

We use data on gini coefficient of income inequality from a sub-sample of countries in our sample to estimate the income inequality equation in (2).[13] In estimating the *gini* equation, we treat both corruption and income growth rate as endogenous as argued in section 3. The 2SLS estimates are presented in Table 6. Column 2 presents the coefficient for *corrupt* when we regress *gini* on a constant and *corrupt*, column 3 presents estimates when we add additional regressors, while column 4 presents coefficient estimates when we add additional regressors and interaction of the regional dummies with *corrupt*. The coefficient of *corrupt* in column 2 is negative and significantly different from zero at $\alpha = 0.01$, suggesting that high levels of corruption are associated with high income inequality. Adding more regressors to the *gini* equation (column 3) does not *qualitatively* change the coefficient of *corrupt* although the degree of precision and absolute magnitude of the estimate decreases (it is still significant at $\alpha = 0.01$). This suggests that corruption has a robust and statistically significant effect on income inequality in our sample. The coefficients of $\dot{y}$ and *edu* are negative while that of *govcon* is positive and all are significantly different from zero at $\alpha = 0.01$ in the *gini*

[13] There are a total of 164 observations made of 52 countries observed over 2–4 periods each. We note that this is an unbalanced sample. Countries in this sample are: Argentina, Australia, Belgium, Bolivia, Brazil, Cameroon, Canada, Chile, China, Colombia, Cote d’Ivoire, Denmark, Equador, Egypt, Finland, France, Ghana, Greece, Hong Kong, Hungary, India, Indonesia, Israel, Italy, Japan, Kenya, Korea, Malawi, Malaysia, Mauritius, Mexico, Morocco, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Peru, Philippines, Portugal, Senegal, Spain, Sweden, Switzerland, Thailand, Tunisia, United Kingdom, United States, Uruguay, Venezuela, Zambia, and Zimbabwe.

equation. This suggests that higher levels of education and faster income growth are negatively correlated with income inequality while high government consumption is correlated with income inequality.

Column 4 adds dummy interaction terms for Africa, Asia, and Latin America to the regressors in column 3. The coefficients of all three regional dummy interaction terms are negative and significantly different from zero at $\alpha = 0.01$. While the absolute magnitude of the coefficient of *corrupt* decreases by about 25% when the regional dummies are included in the *gini* equation, its precision remains unchanged. Test statistics to test the null hypothesis that the coefficients of the three regional interaction terms are jointly equal to zero produced an F statistic of 29.869, leading us to reject the null. This indicates that there are statistically significant regional differences in the effects of corruption on income inequality in our sample. The coefficient estimates suggest that the impact of corruption on income inequality is highest in Latin America, followed by Africa, Asia, and OECD countries in that order. The conclusion we draw from this is that corruption significantly increases income inequality and that the effects differ across regions in our sample. Our result that corruption is positively correlated with income inequality is similar to the results obtained by Gupta et al. (2002), Gray and Kaufmann (1998), Gyimah-Brempong (2002), Hendriks et al. (1998) and Li et al. (2000). Our result is also consistent with the results obtained by Chong and Calderon (2000) who find that the poorer a country is, and the later economic growth starts, the larger the influence of institutional quality on economic growth.

The estimates from the *gini* equation indicate that there are statistically significant regional differences in the impact of corruption on income distribution. A one standard deviation increase in corruption directly increases the gini coefficient of income inequality (0–1 scale) by about 0.05 points in OECD countries, 0.14 points in Asian countries, 0.25 points in African countries and by 0.33 points in Latin American countries. In addition to the direct effect, it is possible that the regional differences in the impact of corruption on income distribution could be increased through differential growth effects of corruption across regions. The differential distributional effect we estimate is therefore likely to be a lower bound of the effect of corruption on income inequality.

The policy implications flowing from the results of this study is that income growth and distribution can be greatly enhanced by reducing corruption. The effect of decreasing corruption on economic performance is highest for African and Latin American countries, regions of the world that need the most improvement in living standards. Decreasing corruption by 10% will increase the growth rate of per capita income by between 1.7 and 2.8%. For most poor countries, especially African countries for whom decreased corruption offers the most growth benefit, this increase in the growth rate of per capita income is large enough to reverse decades of economic stagnation. Our results also imply that reducing corruption will reduce income inequality, thus spreading the benefits of economic growth to a large segment of the population. A one standard deviation decrease in corruption decreases the gini coefficient of income inequality by between 0.05 points (OECD countries) and 0.33 points (Latin America).

Perhaps, the most important policy implication flowing from our results is that the poorest and the slowest growing regions of the world – Africa and Latin America – have the most need to pursue reforms to reduce the negative impacts of corruption on economic growth and income distribution. Although we have indicated that decreasing corruption will increase the growth rate of income as well as improve income distribution, we do not have any policies to recommend to decrease corruption. The issues involved are beyond the scope of this paper. While there is no easy way to reduce corruption, any effort will involve both domestic institutional reforms and international cooperation (Klitgaard 2000; Hellman et al. 2000).

6. Conclusion

This paper uses a panel data and a dynamic panel estimator to investigate regional differences in the effects of corruption on the growth of, and the distribution of income. Using TI's and BI's corruption perception index to measure corruption, we find that corruption has a negative, large, and statistically significant effect on the growth rate of per capita income. We find significant regional differences in the effects of corruption on economic growth and income distribution. The largest negative effect of corruption on the growth rate of income is found in Africa while the largest negative impact of corruption on income distribution occurs in Latin America. A 10% increase in corruption decreases the growth rate of income by between 1.7 and 2.8% while a one standard deviation increase in corruption increases income inequality by between 0.05 points and 0.33 points. These regional differences are perhaps due to differences in the *character* of corruption rather than to differences in the *levels* of corruption. The growth effects occur directly and indirectly through decreased investment in physical capital. The result is robust to different specifications, samples, alternative measures of corruption, and alternative measures of investment. Our results imply that reducing corruption will not only increase the growth rate of income, it will improve the distribution of income.

Our results suggest that different regions of the world should put differential emphasis on policies to reduce corruption as a way of increasing economic growth and improving income distribution. While reducing corruption in African and Latin American countries may be critical for accelerating economic growth, it may not be that critical for economic growth and income distribution in OECD and Asian countries. If our results hold true, then decreasing corruption across all countries by the same proportion will not only increase economic growth rate and improve income distribution in all regions of the world, it will also help to narrow the income and distributional gaps across regions, since the poorest regions will benefit the most from reductions in corruption. However, our results should be interpreted cautiously since the measure of corruption we use here is, at best, the *perception* of corruption. Perceptions may be different from reality.

Acknowledgements We thank two anonymous referees of *this Journal* for helpful comments. The usual disclaimer holds.

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