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THE CAUSALITY BETWEEN CORRUPTION, POVERTY AND GROWTH:

A PANEL DATA ANALYSIS

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AVANT-PROPOS

Le Secrétariat d'Appui Institutionnel à la Recherche Économique en Afrique (SISERA) a pour mission de faciliter l'émergence de centres d'excellence en recherche économique en Afrique subsaharienne et de les aider à jouer un rôle effectif dans le processus d'élaboration des politiques économiques. Un des objectifs du Secrétariat est d'aider les centres à disséminer les résultats de leurs travaux de recherche.

Les Cahiers du SISERA ont donc été créés pour permettre une meilleure diffusion des travaux de recherche des Institutions partenaires du Secrétariat. La présente édition des Cahiers du SISERA est consacrée à diffusion des résultats des études conduites par six Institutions partenaires du SISERA dans le cadre du programme de formation et de recherche en économie dénommé « Stratégies et analyses pour le développement et l'accès à la croissance (SAGA) » mis en place par l'USAID et administré par SISERA. L'objet de ce programme est d'accroître les capacités africaines à produire une recherche de haut niveau qui réponde aux préoccupations politiques, sur des aspects essentiels touchant le développement économique et l'accès à la croissance en Afrique subsaharienne.

Dans le cadre de ce programme, le SISERA a organisé une mise en compétition de projets de recherche, destinée à financer des propositions soumises par des centres africains de recherches économiques. Six propositions ont été financées et les études ont été conduites sur une période d'environ deux ans, de novembre 2003 en mars 2006. Les six Institutions partenaires dont les propositions ont été retenues sont, ''African Institute of Applied Economics (AIAE)'' du Nigeria, le Centre d'Études et de Recherche en Économie et en Gestion (CEREG) de l'université Yaoundé II au Cameroun, le Centre de Recherches Économiques Appliquées (CREA) de l'université Cheikh Anta Diop du Sénégal, le Centre Ivoirien de Recherche Économique et Social (CIRES) de l'université de Cocody en Côte d'ivoire, ''Development Policy Research Unit (DPRU) de l'université du Cape en Afrique du Sud, et le ''Namibian Economic Policy Research Unit (NEPRU), Windhoek, Namibie. Les études ont été réalisées pendant la période novembre 2003 en mars 2006.

FORWORD

The mission of the Secretariat for Institutional Support for Economic Research in Africa (SISERA) is to facilitate the emergence of centers of excellence in economic research in sub-Saharan Africa, and to help them play an effective role in the economic policymaking process. One of the objectives of the Secretariat is to help the centers disseminate the findings of their research works.

The SISERA Working Papers Series was designed to provide an outlet for the research output of the Secretariat's Partner Institutions. This edition of the Working Papers is devoted to the dissemination of the results of studies conducted within the framework of the training and research program ''Strategies and Analyses for Growth and Access (SAGA)'' set up and funded by USAID and administered by SISERA. The overall goal of SAGA is to increase African capacity to produce high quality, policy-oriented research on key issues affecting economic growth and access in sub-Saharan Africa.

In relation with this program, SISERA has organized a research competition program to support research projects carried out by African economic research institutes. Six propositions were selected for funding and the related studies were implemented over about two years from November 2003 to March 2006. The six successful research proposals were submitted by the African Institute of Applied Economics (AIAE) in Nigeria, ''Centre d'Études et de Recherche en Économie et en Gestion (CEREG)'', University of Yaoundé II, Cameroon, ''Centre de Recherches Économiques Appliquées (CREA), Université Cheikh Anta Diop, Senegal, ''Centre Ivoirien de Recherche Économique et Social (CIRES)'', University of Cocody, Côte d'ivoire, Development Policy Research Unit (DPRU), University of Cape Town, South Africa, and the Namibian Economic Policy Research Unit (NEPRU), Windhoek, Namibia.

Abstract

The main purpose of this study was to shed more light on the links between corruption, poverty and growth based on the notion of causality in the context of panel data. The study aims specifically at: i) determining whether corruption causes growth or vice-versa; ii) determining whether poverty causes growth or vice-versa; or iii) whether it is the combine effect of corruption and poverty that causes growth. The link between corruption, poverty and growth was analyzed in a panel of 18 African countries for the 1996-2001 time periods. Indicators of poverty and corruption were identified and tests of the causal relationship between these variables were conducted using panel data analysis. The empirical results suggest that: 1) it is poverty that causes growth but not the other way around. This implies that past information of the state of human development help improve prediction on growth; 2) it is the state of growth that causes corruption and inequality; 3) It is corruption that causes inequality; 4) corruption and poverty together cause growth; 5) poverty and growth together cause corruption; 6) and lastly, inequality together with growth cause corruption.

Keywords: Corruption, Poverty, Growth, Panel Data Analysis, and Causality.
JEL Classification: C12; C23; I32; O40

Résumé

L'objectif principal de l'étude était de permettre une meilleure compréhension des relations entre corruption, pauvreté et croissance en utilisant des données de panel. De façon spécifique, il s'agissait de 1) déterminer si c'est la corruption qui cause la croissance ou vice-versa ; 2) si c'est la pauvreté qui cause la croissance ou vice-versa ; ou 3) si c'est l'effet combiné de la corruption et de la pauvreté qui cause la croissance. La relation entre pauvreté corruption et croissance a été analysée en utilisant un panel de 18 pays africains sur la période 1996-2001. Des indicateurs de corruption et de pauvreté ont été identifiés et des tests de causalité ont été conduit. Les résultats empiriques suggèrent que : la pauvreté cause la croissance et non le contraire. Ainsi, la connaissance de l'état de pauvreté d'un pays (en terme de développement humain) peut permettre d'apprécier son niveau de croissance. En outre, la croissance cause la corruption et l'inégalité ; la corruption cause l'inégalité ; la corruption et la pauvreté causent la croissance ; la pauvreté et la croissance causent la corruption et enfin l'inégalité et la croissance causent la corruption.

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1. INTRODUCTION AND PROBLEM STATEMENT

A key requirement of sustained economic growth is that the governance and equity system be under control. Despite its increased recognition, however, this important prerequisite is often difficult to meet by developing countries, but also by developed countries. Given that most countries have constitutional or statutory limitations restricting their ability to run economic recessions or slowdowns [e.g., see Tanner and Liu (1994), Quintos (1995)], the question of whether the governance and/or equity system is a good predictor for economic growth or vice versa is of high significance for examining whether and how this requirement can be met [e.g., see Bohn and Inman (1996)].

While many studies have examined the relationship between (i) corruption and development, (ii) corruption and growth, (iii) corruption and poverty [e.g., see Bardhan, 1997; Mauro, 1995; Knack and Keefer, 1996; Tanzi and Davoodi, 1997], the question of whether a causal relationship exists between, corruption, poverty and economic growth based on panel data models, has received less attention, particularly for African countries. In this research we aim at filling this gap by extending the existing literature on this matter.

Indeed, a burgeoning empirical literature suggests that the absence of corruption accelerates economic growth, these studies generally do not simultaneously examine poverty development. More specifically, Tanzi and Davoodi (1997) show that the absence of corruption helps explain economic growth, while Gupta et al. (1998) show that the positive relationship between the absence of corruption and growth is not due to simultaneity bias. They omit measures of poverty developments because measures of poverty developments for a long time period are only available for about 40 countries. Omitting the poverty variables makes it difficult to assess whether (i) the negative relationship between corruption and growth when controlling for poverty, is due mainly to corruption (ii) corruption and poverty each have an independent impact on economic growth, or (iii) corruption and poverty matter for growth but it is difficult to identify their separate impact on economic growth.

This research differs from existing studies on the causality between corruption, poverty and economic growth based on panel data in five significant respects: First, it is based on recent causality methods developed for panel data [e.g., see De Melo, 1999; Frankel and Romer, 1999; King and Levine, 1993; Levine, 1998 and 1999; Levine and Zervos., 1998; Levine, et al., 2000; Mauro, 1997]. Second, in view of recent economic recessions and slowdowns that many developing countries and particularly African countries are still experiencing, this paper expects to shed light on whether these economic imbalances (which could eventually prove unsustainable) could be resolved by a clear and comprehensible understanding of the link between governance and/or equity system and economic growth. Third, large and persistent economic recessions and slowdowns were heightened by the Mexican crisis of 1994 and its contagion effects in many developing countries. This calls attention to the risks and temptation to attribute economic recessions and slowdowns to corrupted and/ or poor countries and vice versa. Fourth, the apparent failure of traditional factors explaining economic recessions and slowdowns has spurred renewed interest in the study of ‘early-warning’ indicators that could help predict the emergence of economic recessions and slowdowns crises [e.g., see Gian et al., 1996]. Fifth, this study provides evidence on the governance and/or equity system and economic growth relationship debate by using international data from a sample of African countries. The use of international data enhances the robustness of our empirical findings by potentially revealing general and specific information on the vastly different economies of the countries studied. For example,

in some African countries with relatively high economic growth rates, the judiciary system and the redistribution process are likely to provide a substantial confidence and solidity in institutions. For these countries, therefore, the configuration of institutions may affect the degree of corruption and the redistribution system without transmitting them to the economic growth process. By contrast, other African countries with modest or even negative economic growth rates, the absence of a secured juridical environment, the impact and distributional consequences of corruption [e.g., see Ravallion, 1997], the exacerbation of the state of poverty and inequality in these countries, have certainly hindered efficient development programs and therefore could have affected economic growth.

Our analysis of different country episodes follows a non-structural, case study approach. This allows us to take into consideration a broader set of factors than those that can be encompassed in a testable, state-of-the-art model of economic recessions and slowdowns explanation. Finally, we view this approach as complementary to studies previously conducted on developing countries. Thus, the study offers a new avenue to a number of potential explaining indicators of economic recessions and slowdowns insufficiently or never investigated.

From the above perspectives, the approach discussed here is an extension of the ones adopted by Bardhan (1997), Knack and Keefer (1996), Mauro (1995), Tanzi and Davoodi (1997), respectively. The study is based on 'stylized facts' in Africa, because of long traditional economic imbalances in African countries. Since their independence in the 1960s, African countries have experienced many economic disturbances including economic recessions, economic slowdowns and contractions, coupled with high rates of corruption and / or poverty rates. In addition major international development agencies have typically identified the African continent as a place where corruption, poverty and low or even negative economic growth co-exist, perhaps peacefully but actively. The co-existence of these major contributors to economic growth rates, not only creates a vicious circle, but also elects this, *ipso facto,* for a serious empirical investigation.

2. OBJECTIVES

The main purpose of this paper is to improve the understanding of the relationship between corruption, poverty and growth based on the notion of causality in the context of panel data.

The specific objectives are:

- To determine whether corruption causes growth or vice-versa;
- To determine whether poverty causes growth or vice-versa;
- To determine whether it is the combined effect of corruption and poverty that causes growth.

3. DATA AND METHODS OF ANALYSIS

We analyze the link between corruption, poverty and growth in a panel of 18 African countries for the 1996-2001 time periods. The data were obtained from the World Bank Development Indicators 2003 and the Transparency International Index. Moving to a panel from pure cross-sectional data allows us to deal rigorously with simultaneity. The theories we are evaluating focus on the relationships between corruption, poverty and economic growth. Economic growth is captured through the growth rate of gross domestic product (GDP_{it}).

To measure *corruption (COR_{it})*, we used the *Transparency International* corruption perception indices from 1996 to 2001.

To measure *poverty (POV_{it})*, we use the Human Development Index (HDI_{it}) for the simple reason that data series on poverty incidence, poverty gap etc were not available for the countries of interest. Moreover, the data on consumption and income could not truly capture the state of poverty in the countries being studied. This is why on a final analysis we decided to use the HDI indicator which we believe portrays in a more satisfying way the state of poverty in developing countries. We also considered the issue of equity in the countries under study and investigate whether and how corruption and growth affect the distribution of inequality in these countries. We used the income inequality data of Sala-i-Martin. To avoid the problem of endogeneity bias in the model specification, we used lagged values of the poverty, corruption and growth variables in the right hand side of the models considered. Before lagging the variables, a logarithmic transformation was applied to stabilize the variance of the data (Except for GDP since we have negative GDP growth rate). That is, $LPOV_{it}$ stands for lag of the logarithm of the POV_{it} variable and so on. Corruption, Poverty and Inequality are the candidate causal variables. They are represented by the variable X_{1it}. GDP_{it} is the left-hand side variable and is represented by Y_{it}.

To assess the strength of the independent link between both corruption and growth and poverty and growth, we control for other potential determinants of economic growth in our regressions. These control variables are included in the X_{2it} variables. In the *simple conditioning information set* we include the population growth rate (POP_{it}) to control for convergence, the literacy rate (TA_{it}) to control for human capital accumulation and Investment (INV_{it}). In the *policy conditioning information set*, we use the simple conditioning information set plus the inflation rate (CPI_{it}).

As to the research methods, and following Hsiao (2003), many of the panel data models can be treated as special cases of a general mixed fixed and random coefficients model. Let assume that only time-invariant cross-sectional heterogeneity exists and suppose that each cross-sectional unit is postulated to be different, so that

$$y_{it} = \sum_{k=1}^{K} \beta_{ki} x_{kit} + \sum_{l=1}^{m} \gamma_{li} w_{lit} + u_{it} \qquad (1)$$

$i = 1, \ldots, N$, $t = 1, \ldots, T$,

Where x_{it} and w_{it} are each a K x *1* and an m x *1* vector of explanatory variables that are independent of the error of the equation, u_{it}. Stacking the NT observations together, we have

$$Y = X\beta + W\gamma + u \qquad (2)$$

Where

$$\underset{NTxNK}{X} = \begin{pmatrix} X_1 & 0 & \ldots & 0 \\ 0 & X_2 & \ldots & 0 \\ \vdots & & \ddots & \vdots \\ 0 & & & X_N \end{pmatrix}, \qquad \underset{NTxNm}{W} = \begin{pmatrix} W_1 & 0 & \cdots & 0 \\ 0 & W_2 & \cdots & 0 \\ \vdots & & \ddots & \vdots \\ 0 & & & W_N \end{pmatrix}, \qquad \underset{NTx1}{u} = \left(u_1', \cdots, u_N' \right),$$

$\underset{NKx1}{\beta} = \left(\beta_1', \cdots, \beta_N'\right)'$ and $\underset{NKx1}{\gamma} = \left(\gamma_1', \cdots, \gamma_N'\right)'$.

Equation 1, like equation 2, assumes a different behavioral equation relation for each cross section unit. In this situation, the only advantage of pooling is to put model 2 in Zellner's (1962) seemingly unrelated regression framework to obtain efficiency of the estimates of the individual behavioral equation. The motivation of a mixed fixed and random coefficients model is that while there may be fundamental differences among cross-sectional units, by

conditioning on these individual specific effects one may still be able to draw inferences on certain population characteristics through the imposition of a priori constraints on the coefficients of x_{it} and w_{it}. We assume that there exist two kinds of restrictions, random and fixed in the following form:

- The coefficients of x_{it} are assumed to be subject to random restrictions of the form

$$\beta = A_1\bar{\beta} + \alpha \qquad (3)$$

where A_1 is an NK x L matrix with known elements, $\bar{\beta}$ is an L x 1 vector of constants, and α is assumed to be (normally distributed) random variables with mean 0 and nonsingular constant covariance matrix C and is independent of x_{it}.

- The coefficients of w_{it} are assumed to be subject to

$$\gamma = A_2\bar{\gamma}, \qquad (4)$$

where A_2 is an Nm x n matrix with known elements, and $\bar{\gamma}$ is an nx1 vector of constants. Since A_2 is known, we may substitute equation 4 into 3 and write the model as follows:

$$Y = X\beta + \overline{W}\bar{\gamma} + u \qquad (5)$$

Subject to equation 3, where $\overline{W} = WA_2$.

The above equation allows for various possible fixed parameter configurations. For instance, if γ is different across cross-sectional units, we can let $A_2 = I_N \otimes I_m$. On the over hand, if we wish to constrain $\gamma_i = \gamma_j$, we can let $A_2 = e_N \otimes I_m$. Many of the linear panel data models with unobserved individual specific but time-invariant heterogeneity can be treated as special cases of the models in equations 2 to 4. These include:

i) A common model for all cross-sectional units. If there is no inter-individual difference in behavioral patterns, we let **X = 0**, $A_2 = e_N \otimes I_m$, so equation 2 becomes

$$y_{it} = w_{it}'\bar{\gamma} + u_{it}. \qquad (6)$$

ii) Different models for different cross-sectional units. When each individual is considered different, then **X = 0**, $A_2 = I_N \otimes I_m$, and equation 2 becomes

$$y_{it} = w_{it}'\gamma_i + u_{it} \qquad (7)$$

iii) Variable-intercept model. If conditional on the observed exogenous variables, the inter-individual differences stay constant through time. Let **X = 0**, and

$A_2 = \left(I_N \otimes i_m, \vdots e_N \otimes I_{m-1}^*\right)$, $\bar{\gamma} = \left(\gamma_{11}, \cdots, \gamma_{N1}, \bar{\gamma}_2, \cdots, \bar{\gamma}_m\right)'$, where we arrange $W_i = \left(e_T, w_{i2}, \ldots, w_{im}\right)$, $I = 1, \ldots, N$, $i_m = (1,0,\ldots,0)'$ and $\underset{mx(m-1)}{I_{m-1}^*} = \left(0 \vdots I_{m-1}\right)'$. Then equation 2 becomes

$$y_{it} = \gamma_{i1} + \bar{\gamma}_2 w_{it2} + \ldots + \bar{\gamma}_m w_{itm} + u_{it}. \qquad (8)$$

iv) Error-components model. When the effects of the individual-specific, time-invariant omitted variables are treated as random variables just as in the assumption on the effects of other omitted variables, we can let $X_i = e_T$, $\alpha' = \left(\alpha_1, \ldots, \alpha_N\right)$, $A_1 = e_N$, $C = \sigma_\alpha^2 I_N$, $\bar{\beta}$ be an unknown constant, and w_{it} not contain an intercept term. Then equation 2 becomes

$$y_{it} = \bar{\beta} + \bar{\gamma}' w_{it} + \alpha_i u_{it} .$$

(9)

v) Random-coefficients model. Let $Z = 0$, $A_1 = e_N \otimes I_K$, and $C = I_N \otimes \Delta$. Then we have the model below:

$$Y = X\bar{\beta} + \tilde{X}\alpha + u$$

(10)

where $\underset{NTx1}{Y} = (y_1', \ldots, y_N')'$, $\underset{NTxK}{X} = \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_N \end{bmatrix}$, $\underset{NTxNK}{\tilde{X}} = \begin{bmatrix} X_1 & & & 0 \\ & X_2 & & \\ & & \ddots & \\ 0 & & & X_N \end{bmatrix} = diag(X_1, \ldots, X_N)$,

$u = (u_1', \ldots, u_N')'$ and $\alpha = (\alpha_1', \ldots, \alpha_N')'$. The covariance matrix for the composite disturbance term $\tilde{X}\alpha + u$ is block-diagonal, with the i^{th} diagonal block given by $\Phi_i = X_i \Delta X_i' + \sigma_i^2 I_T$.

The issue of causality is also tackled. Indeed, in their study on corruption, poverty and growth, Tanzi and Davoodi (1997) show that corruption, poverty are robust predictors of economic growth, but their results do not imply a causal link between corruption, poverty, and economic growth. We extend therefore our study to test for causality between corruption, poverty and growth.

To test the causal relationship between these variables, we considered the Engle-Granger approach developed in 1969. They defined causality between variables in the following way: A given variable *Granger causes* another variable if better predictions of the latter variable are obtained using passed and current information on the first variable (See Granger, 1969 P. 428). Recent developments in the causality analysis have been associated with the concept of cointegration since it has been proven that if two series are cointegrated then, there is Granger causality in at least one direction. However, no cointegration does not imply no causality (Giles and Williams, 1999). In the present paper, we use the Mixed Fixed Random effects (MFR) model approach as presented above to test causality (Nair-Reichert and Weinhold, 2001).

Given that a major limitation of annual data is that there are few of them for each country, we consider panel data analysis. Panel data models can be used to increase the degrees of freedom, widen the range of variables, and generalize results across cross-sectional units. Our mixed fixed-random effects panel data equations to be estimated are as follows:

$$Y_{it} = \alpha_i + \gamma_i Y_{it-1} + \beta_{1i} X_{1it-1} + \beta_2 X_{2it} + \varepsilon_{it}$$

(11)

Where $i = 1, \ldots, N$; $t = 1, \ldots, T$ and N is the number of countries, T is the number of years; $\beta_{1i} = \bar{\beta}_1 + \eta_i$ and X_{1it-1} denotes the orthogonalized candidate causal variable after the linear influences of the other right-hand side variables have been removed. Orthogonalization is necessary to ensure that the coefficients are independent which in turn allows their estimated variances to be appropriately interpreted. The advantage of the MFR model is that it can be used to control for the effects of both the fixed and random country specific factors so that parameters characterizing common behavior across countries and over time can be consistently estimated. The MFR model is ideally suited for testing the presence of causality in heterogeneous panel data sets as it allows for a distribution of causality across the panel (Nair-Reichert and Weinhold, 2001).

Equation (11) is estimated using the PROC MIXED procedure in SAS 8.1.

4. EMPIRICAL EVIDENCE

The present section analyses the empirical results. These results are shown in tables 1 to 4. Table 1, presents the results from estimating the growth equation. Let recall that in specification one (model 1), the poverty variable is measured as Human Development Index (HDI). In specification two (model 2), we use the inequality variable measured as income inequality. In respect of the empirical evidence, the estimated equation suggests what follows: from model 1, we observe that the poverty variable is positively and significantly linked to growth (linear as well as quadratic term). This result suggests that countries with low level of Human Development register low economic growth and countries with high level of Human Development enjoy high economic performance. Moreover, this result suggests that a country's economic performance is positively affected by an improved level of Human Development. The corruption variable has a negative but not significant impact on growth. A similar result is obtained when corruption and poverty are combined.

In model two, as indicated above, the variable of interest is inequality measured as income inequality. The result suggests a significant negative impact of inequality on economic growth. The quadratic term included in this equation is not significant. The combined effect of inequality and corruption is not significant.

Table 1: Estimates of mixed fixed-random effects model for the growth equation.

Variables	Model 1[a]	Model 2
Constant	12.495	9.254
	(0.211)[b]	(0.169)
GDP_{t-1}	0.105	0.147
	(0.258)	(0.115)
$LCOR_{t-1}$	-1.789	0.387
	(0.627)	(0.533)
$LPOV_{t-1}$	30.606*	-0.201*
	(0.046)	**(0.049)**
$LPOV_{t-1}^2$	22.024*	0.003
	(0.001)	(0.136)
$CORPOV_{t-1}$	-2.149	0.014
	(0.677)	(0.691)
CPI_t	-2.618*	-3.399*
	(0.001)	**(0.000)**
INV_t	4.215*	3.310*
	(0.000)	**(0.002)**
POP_t	0.097	-0.786
	(0.931)	(0.484)

[a] In model 1, the poverty variable is measured as Human Development Index (HDI); and in model 2, poverty is measured as income inequality.

[b] Number in parentheses are P-value of the statistics. A single asterisk is an indication of significance at the 5% level and a double asterisk is an indication of significance at the 10% level.

Table 2, presents the estimates of the mixed fixed-random effects model for the corruption equation. Here also, two models were estimated as indicated earlier. The estimated random effects equations suggest the following results: From model 1, lagged GDP affect

significantly the level of corruption. Poverty (HDI) has no significant effect on corruption. From model 2 we also observe that lagged GDP affect corruption significantly. Here also, poverty does not have a significant impact on corruption.

Table 2: Estimates of mixed fixed-random effects model for the corruption equation.

Variables	Model 1[a]	Model 2
Constant	1.114	1.086
	(0.119)[b]	(0.132)
$LCOR_{t-1}$	-0.046	-0.065
	(0.383)	(0.179)
GDP_{t-1}	0.009	0.009
	(0.157)	(0.185)
GDP_{t-2}	0.016*	0.016*
	(0.015)	**(0.021)**
$LPOV_{t-1}$	-0.076	0.001
	(0.512)	(0.242)
POP_t	-0.045	-0.093
	(0.721)	(0.482)
CPI_t	-0.076	-0.054
	(0.317)	(0.493)
INV_t	0.149	0.152
	(0.178)	(0.169)
$CORGDP_{t-1}$		0.0002
		(0.426)

[a] In model 1, the poverty variable is measured as Human Development Index (HDI); and in model 2, poverty is measured as income inequality.

[b] Number in parentheses are P-value of the statistics. A single asterisk is an indication of significance at the 5% level and a double asterisk is an indication of significance at the 10% level.

Table 3, presents the estimates of the mixed fixed-random effects model for the poverty equation. The empirical results suggest the following. From model 1, we observe that economic growth neither has a significant impact on poverty nor on inequality. The corruption variable also does not affect poverty. From model 2, corruption has a significant negative effect on inequality. Given that corruption (CPI) is measured on a scale from 1 to 10, where a rank close to 1 is an indication of high corruption and a rank close to 10 is an indication of low corruption, the empirical result here suggests that as countries get less corrupted (increase CPI), it reduces income inequality in those countries. Moreover, as countries get more corrupted (a decrease of CPI), it increases income inequality in those countries. The other variables are not significant.

Table 3: Estimates of mixed fixed-random effects model for the poverty equation.

Variables	Model 1[a]	Model 2
Constant	-0.755	24.011
	(0.003)[b]	(0.623)
$LPOV_{t-1}$	0.002	0.417*
	(0.953)	**(0.000)**
GDP_{t-1}		1.457
		(0.577)
GDP_{t-2}	0.002	
	(0.276)	
$LCOR_{t-1}$	-0.008	-0.473
	(0.514)	(0.941)
$LCOR_{t-2}$		-9.584*
		(0.032)
$CORGDP_{t-1}$	0.0004	-0.649
	(0.708)	(0.750)
CPI_t	-0.013	-4.157
	(0.473)	(0.498)
POP_t	-0.016	-6.906
	(0.587)	(0.429)
INV_t	0.067*	7.160
	(0.009)	(0.379)

[a] In model 1, the poverty variable is measured as Human Development Index (HDI); and in model 2, poverty is measured as income inequality.
[b] Number in parentheses are P-value of the statistics. A single asterisk is an indication of significance at the 5% level and a double asterisk is an indication of significance at the 10% level.

In table 4, we present the results of the Granger causality tests. The results suggest what follows:

- *Poverty and economic growth*

From model 1, poverty causes growth. That is, past information on poverty help improve prediction of economic growth. Here, we shall recall that poverty is measured as Human Development Index. We also tested the hypothesis that, it is growth that causes poverty. The results from models 1 show that, it is poverty that causes growth but not the other way around. There is therefore unidirectional causality going from poverty to growth. The results from model 2 suggest that growth does not cause inequality and inequality does not cause growth.

Table 4: Granger causality tests results

Hypotheses	Model 1	Model 2
Poverty *causes* Growth[a]	4.640*	2.140
	(0.013)	(0.125)
Growth *causes* poverty[c]	1.200	0.310
	(0.276)	(0.577)
Corruption *causes* Growth[a]	0.240	0.390
	(0.627)	(0.533)
Growth *causes* Corruption[b]	4.450*	4.030*
	(0.015)	**(0.022)**
Poverty *causes* Corruption[b]	0.430	1.390
	(0.512)	(0.242)
Corruption *causes* Poverty[c]	0.430	3.170*
	(0.514)	**(0.048)**
Corruption and Poverty *cause* Growth	2.370**	1.930
	(0.060)	(0.114)
Corruption and growth *cause* poverty	0.520	1.940
	(0.670)	(0.112)
Poverty and Growth *cause* corruption	2.970*	2.530*
	(0.037)	**(0.047)**

[a] F-statistics resulted from equations in table 1.
[b] F-statistics resulted from equations in table 2.
[c] F-statistics resulted from equations in table 3.
Numbers in parentheses are P-value of the statistics. A single asterisk is an indication of significance at the 5% level and a double asterisk is an indication of significance at the 10% level.

- *Corruption and economic growth*

The next set of hypotheses tested has to do with corruption and growth. The results from the two specifications are that corruption does not cause growth. Rather, it is growth that causes corruption. Hence, causality here is unidirectional. Past information on economic performance can help improve prediction of corruption level. Indeed, field evidence demonstrates that as countries get richer, they are subject to less corruption *ceteris paribus* and poor countries are subject to more corruption. Knowing a country's economic performance overtime could provide an insight of its corruption status. Similar result is obtained for model 2 that is, growth causes inequality.

- *Poverty and corruption*

We also investigated the direction of causality between poverty and corruption. The empirical evidence shows that from model 1, poverty does not cause corruption and corruption does not cause poverty. From model 2, we have uni-directional causality. That is, inequality does not cause corruption but corruption causes inequality.

- *Corruption, poverty and growth*

Here, the concern is on the combined effects of corruption and poverty on economic growth. it appears from model 1 that the combination of corruption and poverty cause growth. That is, past information on state of corruption and poverty in a country can help improve prediction of that country's economic performance. This empirical evidence clearly show that in addition to the impact of corruption and poverty variables taken individually, on economic growth which has always been portrayed in most studies, the combined effects of these two variables is of great importance and is worth considering.

- *Poverty, growth and corruption,*

Here, we look at the combined effect of poverty and growth on corruption. We observe that from model 1, poverty and growth together cause corruption. We also observe that inequality together with growth cause corruption. That is, past information on the level of growth and the state of corruption in a country can help improve prediction of the state of corruption.

5. CONCLUDING COMMENTS

The main purpose of this paper was to increase the understanding of the relationship between corruption, poverty and growth based on the notion of causality in the context of panel data. The specific objectives of the paper were to: i) determine whether corruption causes growth or vice-versa; ii) determine whether poverty causes growth or vice-versa; or iii) whether it is the combine effect of corruption and poverty that causes growth. The link between corruption, poverty and growth was analyzed in a panel of 18 African countries for the 1996-2001 time periods. Indicators of poverty and corruption were identified and tests of the causal relationship between the corruption, poverty and growth variables were conducted using panel data analysis. The following results were obtained:

- *Poverty and growth;*

When poverty is measured as Human Development Index (model 1), the empirical evidence suggest that poverty causes growth but not vice-versa. When inequality is used (model 2), the results show no causality in either direction.

- *Corruption and growth*

The empirical evidence suggests that corruption does not cause growth. Rather, it is growth that causes corruption.

- *Corruption and poverty*

There is no causality in either direction between corruption and poverty (models 1). However, in model 2, the empirical evidence shows that inequality does not cause corruption but rather, corruption does cause inequality.

- *Poverty, corruption and growth*

Poverty and corruption together cause growth that is, these flaws should be tackled together in a global framework and not considered separately. As long as poor people will live side by side with wealthy ones and as long as they will feel abandoned, excluded from the decision making chain, they will accept to be corrupted. This in turn will have a negative bearing on a country's economic performance.

- *Poverty, growth and corruption*

Poverty and growth together cause corruption (from model 1) and inequality together with growth cause corruption (from model 2).

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APPENDIX: LIST OF COUNTRIES INCLUDED IN THE PANEL

1. Botswana	7. Malawi	13. South Africa
2. Cameroon	8. Mauritius	14. Tanzania
3. Egypt	9. Morocco	15. Tunisia
4. Ghana	10. Namibia	16. Uganda
5. Ivory Coast	11. Nigeria	17. Zambia
6. Kenya	12. Senegal	18. Zimbabwe

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