

# Poverty, Governance and Sustainable Development: A Panel Data Study

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## Abstract

Over the last few decades attention has shifted towards the multifaceted issues contained within the concept of sustainable development which emphasises promoting the well-being of the present generation without compromising the well-being of future generations .The debate over the linkages between poverty and the environment in both the literature and policy contexts has reached two opposing view points: the first points out that poor people are the main agents for environmental degradation due to lack of resources and their struggle to ensure day-to-day basic needs.The second view point regards poor people as the victims of environmental degradation rather than the cause and stresses that economic growth (income per capita ) is the major cause of environmental degradation. In this context there is an urgent need for good governance to integrate public, government and environment for the aim of reducing poverty and improving sustainability The purpose of this paper is to attempt to investigate the causal relationships between poverty, governance and sustainability combining growth and poverty models with the Environmental Kuznets Curve (EKC) model considering the role of institutional quality using a panel of 59 countries over the period 1996-2008 .The aim of this is to build an integrated model linking the issues of sustainability and governance to the worsening problem of poverty in developing countries.

**JEL Classification:** CO1, C33, C82, I32, O43, Q56

**Keywords:** Environmental Kuznets curve, sustainable development, principal component analysis, simultaneous equation with error components.

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## 1) Introduction

Over the last 15 years new concepts have emerged in development thinking: the concepts of Human Poverty (HP) and sustainable development (SD). The definition of human poverty is based not only on the unavailability of income but also on the capability approach first introduced by Sen (see Sen, A. 1979,1982,1985). Human poverty, it is argued, is more about enlargement of real freedom than increasing economic growth, increased personal income or technological advances (Sen, 1999).

The idea of sustainable development has attracted the attention of both governmental and non-governmental organizations. More emphasis has been given to the environment not only as an agent to limit economic growth (Meadows, Meadows, Randers, & Behrens III, 1972) but also to its vital role in reducing poverty levels and improving well-being and standards of living (Costantini & Monni, 2008).

In 1987 the world commission on environment and development (WCED) offered a widely accepted view of sustainable development focused on development that meets the needs of the present generation without compromising the well-being of future generations (WCED, 1987). The UNDP (1996) also included the environment and more broadly sustainable development as a prime feature in future policy approaches. In 2000 the MDGs developed by the UN recognized sustainable development as one of its goals.

The WECD definition is more comprehensive and broad as it includes the three main dimensions of sustainable development: Economic, Social and Environmental sustainability (Asadi, 2008). Ecological sustainability refers to maintenance of ecosystems and avoidance of natural resource depletion, pollution and reduction in biodiversity (Asadi, 2008). Social sustainability is of crucial importance to development as it emphasises basic education, better health care and access to social security in addition to the administration of the distribution of natural resources between the present and the next generation making development more participatory (Asadi, 2008). Economic sustainability refers to not only reducing poverty but also reducing inequality so that everybody benefits from it (Asadi, 2008).

Poverty in development economics focuses basically on the interface between economic growth and poverty. There are two opposing approaches discussing this interface. It is argued that unless an economy is able to generate stable economic growth poverty reduction is impossible. Economic growth always has spill-over effects on poverty through competitive market structures. South Asian countries for example, exhibited high economic growth and were able to significantly reduce poverty (Paragariya, 2002; Ames, 2000; Dollar, 2002). Contrarily,

some argue that economic growth is necessary but insufficient to reduce poverty due to economic inequality. This lessens the effect of economic growth and may deepen poverty, increase social anger and negatively affect the economic growth process itself (Ravallion, 2001; Bruno, 1998).

There are two approaches used in this paper. First: the impact of environmental quality on the HPI is mainly analysed through a conceptual model based on capabilities variables. Second: the impact of poverty and development on environmental quality which is part of the EKC is examined. The latter is first investigated by using GDP as it is a source of environmental degradation (Grossman & Krueger, 1995; Shafik, 1994). But GDP fails to take into account a number of important factors such as education, health, crime and inequality that have an important impact on human well-being (Hill & Magnani, 2002). Recent research has attempted to examine the link between welfare and the environment focused on the role of human dimensions (Hill & Magnani, 2002; Tisdell, 2001).

## **2) Literature Review**

### **a) Poverty reduction and the role of governance**

There are two opposing arguments in the literature regarding the impact of governance on poverty reduction. First, (Sen, 1999) helped to raise the issue of governance in the development agenda and stated that the presence of State institutions not only helps markets to operate well but also gives the chance for citizens especially the vulnerable to determine their basic needs and share in decision making. Sen also argued that there is a positive relation between income and freedom as good institutions with transparent rules and accountability can divert their income in favor of the poor. (Jenkins, 2005) pointed to the disadvantages of having bad governance especially for the poor as they suffer from denial of access to education, health and shelter in addition to not being able to benefit from markets because of their low income. (Lazarova, 2006) points out that governance is estimated to have negative impacts on infant mortality in a sample of 112 countries representing developed and developing regions. The second strand of views argues that governance is not the *main* determinant of economic performance. This appears to be the conclusion of (Lazarova & Mosca, 2008) on a sample containing both developed and developing countries for the years 1996, 1998 and 2000. They tried to examine the relationship between aggregate health capital and governance. Their analysis showed two types of conclusions. Concerning poor countries, absolute income proved to be a significant determinant of health quality, while for rich countries, governance proved to have a better impact. (Quibria, 2006) begins by dividing the Asian economies into countries that suffer from a governance deficit and countries that suffer from governance surplus. The result of

the analysis shows a very interesting conclusion: countries that suffer from a low level of governance outperformed countries that exhibit governance surplus.

### **b) Poverty and Sustainable Development nexus**

Developing countries nowadays are facing many environmental problems originating from the struggle to overcome poverty as environmental degradation is mainly caused by those who depend mainly on consuming natural resources for survival (poor farmers) and this contradicts with the premises of sustainable development (Bartelmus, 1986). Environmental quality should be considered to maintain permanent sustainable development (Dampier, 1982). Thus conserving the environment and achieving development are no longer contradictions to each other, they become interdependent and in the long run are mutually reinforcing (Tolba, 1984b).

The orthodox approach assumes the existence of a *downward spiral relation* between poverty and environmental degradation (Forsyth, 1998). The rich and the poor are the main agents for environmental degradation. They not only impact the cost of production but also the productivity of crops and people's income. For example destruction of forests, using pesticides and chemical fertilizers in order to increase production leads to environmental degradation either in the form of air pollution or less fertile land (Asadi, 2008). In the long run this increases poverty and in turn leads to less access to resources such as fertile land and appropriate technology. By integrating all these factors and considering the short time goals of poor peasants this leads to more and more environmental degradation (Lele, 1991).

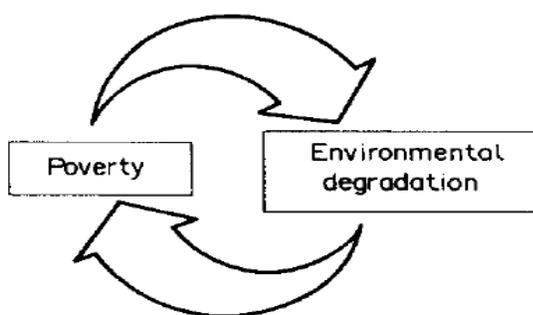


Diagram 1: *Downward spiral relation between poverty and environment degradation*

One of the main conclusions of the Bruntland Commission report is that poverty is the main reason behind environmental degradation. Eradicating poverty is crucial and sometimes a condition for any effective program that targets environmental conservation (Duraiappah, 1998). Along the same lines Jalal (1993) found that

environmental degradation, rapid population growth and stagnant production are accompanied by the fast spread of poverty in the developing countries of Asia. The World Bank (1992) argued that poor families in developing countries meet their short-term preferences (basic needs) through adopting behaviours unfriendly to the environment such as excessive cultivation and cutting trees for firewood.

(Duraiappah, 1998) stated that there are four main agents responsible for environmental degradation and endogenous poverty: power, greed and wealth, exogenous poverty, institutional failures, and finally market failures. He differentiates between two types of poverty, endogenous poverty caused by environmental degradation and exogenous poverty caused by other factors. In addition he separates market failures from institutional failures, as the latter represents mal-defined property rights system and the former represents incorrect market signals. In his analytical framework there are six relationships to explain the poverty – environment nexus. The first states that exogenous poverty causes environmental degradation. The second states that power, wealth and greed causes environmental degradation. The third states that institutional failure is a primary cause of environmental degradation. The fourth states that market failure causes environmental degradation. The fifth states that environmental degradation causes poverty and the sixth states endogenous poverty leads to environmental degradation which drives the downward spiral relation between poverty and environment.

In rural areas of developing regions the majority of the poor depend on agricultural land to ensure their basic needs since agricultural land employment opportunities and agricultural production provides their livelihood in addition to depending on forward and backward linkages from farmers (Reardon & Vosti, 1992). On the other side poverty puts constraints on agricultural growth due to the behavior of the poor in focusing on low value crops to maintain subsistence and their difficulties in mobilizing production and investment resources (Scherr, 2000).

The relation between the environment and human health is complicated. There are driving forces that determine development trends in terms of technology use, consumption behaviors and population growth. These driving forces generate pressures on the environment in the form of depletion of human resources and emissions of pollution as a result of energy production, mineral extraction, agriculture and forestry. These pressures in turn lead to changes in the state of the environment that could be in the form of land degradation or of toxic chemicals released in air, water or soil. These pollutants create hazards to human health which in turn results in dangerous diseases. In turn this depends on the extent of exposure of human beings to the changed state of the environment - and most are the marginalized poor. (Briggs, Corvaldn, & Nurminen, 1996).

### **c) Governance and its role in achieving sustainability and reducing poverty**

Local institutions are the foundations that shape the nexus between the environment and poverty. Effective resource management systems should adopt clear regulations that monitor private sector use of natural resources to mitigate environmental externalities (Scherr, 2000). Good local institutions with effective organizational and managerial skills lead to successful resource management activities (White & Runge, 1994; Veit, 1995). Local institutions should provide support services to the poor that enhance agricultural outcomes and resource conservation. It could be in the form of technical assistance, availability of credit and insurance, monitoring use of natural resources and offering market information (Scherr, 2000). Physical and social infrastructure provided by public institutions need to develop non-farm activities and strengthen rural –urban links (Vosti, 1997). Reardon & Vosti (1992) addressed the concept of ‘conservation investment poverty’ which highlights the limited access of the poor to cash, machinery and other resources for profitable investment. This is attributed to weak institutions and mal-functioning factor markets in many poor rural areas (De Janvry, 1991). A study of 21 projects in Central America and the Caribbean found that land is fragile, weak credit markets dominate and segmented labor markets are typical. The results revealed that by providing households with credit and agricultural land powerful impacts can be achieved for farmers in the selection and management of agro forestry technologies (Current, 1995).

On using natural resources, the problem of property rights is central since these involve rights to access, plan, exclude some and transmit rights to others. The rules that shape property rights are considered to be a source of benefit to marginalized people (Bromley, 1991) as such rights effectively protect assets of the poor that create income, give access to essential needs (e.g. water, fuel, food) and protect them against livelihood risk. Marginalized people (e.g. women and the poor) are heavily affected by poor institutional quality in developing countries because they are mainly subject to customary and informal rights that can be easily removed (Baland & Platteau, 1996; Otsuka & Quisumbing, 1998).

Property rights are one of the forms of good governance and they affect long-term agricultural productivity because they reduce incentives for the poor to deplete resources and raise incentives for investment in resource improvement. For example access to natural resources by women has proved to be very beneficial as it improves not only their welfare but enhances agricultural productivity. Also, it leads to economic returns to agro-forestry and efficient use of water in irrigation projects (Meinzen-Dick, 1997). Tenure security is associated with conservation practices in agricultural land and improvements to the land (Templeton & Scherr, 1999).

Templeton and Scherr (1999) found an inverted U-shape relation between environmental quality and population density in tropical hillsides. As population increases, degradation and agricultural intensification increases due to less concern about the environment. Once stable cultivation is achieved intensification will be accompanied by improvements in tree, water and land conservation. Degradation becomes a problem to farmers when it threatens their livelihoods and thereafter they will tend to successfully adapt positively with the environment. (Scherr, 2000).

### **3) Data and Methodology**

In order to construct the empirical framework, the analysis will be divided into two main sections. The first part tests the robustness of the empirical relation between poverty, governance and the EKC and it contains three sub-sections to determine the impact of each variable on other variables in the overall panel (59 countries) and for different regions over time. The second part attempts to assess the causal relationship between human poverty, governance and the EKC (sustainability) in an integrated model using two stage least squares. Data coverage includes 59 countries from 1996 to 2008 and were obtained from three sources: World Development Indicators (WDI) (2009), the Human Development Report (2009) and Aggregate Governance Indicators 1996-2008 (Kaufman, Kraay, & Mastruzzi, 2008)

#### **3.1) *Cross-section analysis and cross –country analysis***

The panel data on CO<sub>2</sub> emissions and Human poverty are drawn from the WDI and Human Development Report (HDR) respectively to analyze the relation between poverty and environmental degradation for a panel of 59 countries. Data are not homogenous and there is a wide variation among variables of countries chosen for the study. Heteroscedasticity is likely to appear in the error structure of the equations used. For remedy, generalized least squares (GLS) can be used to estimate the cross-section equations (Hill & Magnani, 2002). Alternatively the group means regression can be applied because it uses aggregate information (group means of variables). So, the unit of analysis is not an individual observation and hence the number of observations falls. The group mean regression produces different goodness-of-fit measures and parameter estimates (Park, 2009).

Next, the set of countries are separated into regions: MENA countries, highly indebted countries, sub-Saharan African countries, Asian countries, Central American countries and Latin American countries -this follows the World Bank classification- the data is then recast into time groupings with regional dummy variables to allow the determination of the relation between poverty and environmental degradation over time for different regions.

Again, Heteroscedasticity is likely to be a problem; GLS is used to estimate the equations and group mean regression.

I) Human Poverty (HP) and the role of institutions

The formulation of the poverty equation is represented by equation (1) where the human poverty index (HPI) is used as the dependent variable influenced by conditioning variables. These conditioning variables include non-sustainability variables, human development dimensions, HIV/Aids, foreign aid and quality of institutions.

$$\text{HPI} = \text{CO}_2 + \text{CO}_2^2 + \text{CO}_2^3 + \text{GDP\_HDI} + \text{RL} + \text{VC} + \text{PS} + \text{Ratio\_Sec} + \text{Life\_T} + \text{Aid} + \text{Health} + \text{Hiv/Aids} \quad (1)$$

CO<sub>2</sub> is used as a proxy for non-sustainability as suggested by ( Costantini & Monni, 2008; Hill & Magnani, 2002). The cubic term is used to provide consistent estimates. HD dimensions are represented by the secondary enrollment (ratio\_sec), life expectancy (life\_t) and public health expenditure as % of GDP (health). The degree of a country’s commitment to human development goals is measured by a country’s GDP per capita rank minus its HDI rank ( GDP-HDI). Development aid and HIV/AIDS are used in the equation and provided by Arimah (2004).

Institutional quality data used in this paper are provided by Kaufmann et al. (2008) where six measures describe this variable: rule of law, government effectiveness, regulatory quality, control of corruption, voice accountability and political stability.

Cross- section results from the GLS and GM regressions provide support for the existence of an inverse N-shaped relation between CO<sub>2</sub> emissions and poverty in developing countries as reported in **Table (1)** . As in the earlier stages of development when CO<sub>2</sub> emissions increase poverty levels decrease then increases then decreases again at higher levels of development . This is supported by the work of Birgit Friedl & Getzner (2003) and Martinez-Zarzoao & Bengochea-Morancho (2003) who found an N-relation between pollution emissions and economic growth. The cubic term of CO<sub>2</sub> emissions is used to improve estimates and it is worth noting that the explanatory power of the cubic term increases over the time period (0.89) since this suggests a strong relation between poverty and pollution emissions.

With regard to the effect of commitment to human development goals (GDP\_HDI), this has a negative effect on poverty. The negative effects of the human development dimension come mainly from life expectancy at birth while secondary enrollment and public health expenditure have significantly negative impacts on poverty levels but with very small coefficients. For institutional quality (using GLS) the rule of law (RL) and political stability

(PS) do not significantly impact poverty. Using the GM method, voice accountability (VC) negatively impacts poverty however both the GM and GLS resulted in the wrong sign for political stability due to its high correlation with governance indicators .

The cross –country results obtained from the GLS and GM methods are consistent with the literature as the cubic term of CO<sub>2</sub> emissions results in the inverse N- shape relation between poverty and the environment. The HD dimensions and commitment to HD goals have significantly negative impacts on human poverty. Foreign aid negatively impacts poverty in developing countries and this finding is in line with the World Bank (1998) which argues that foreign aid is not transferred to poor countries because they are deeply needed but to strategic allies for other purposes.

Regarding the regional dummies in the GLS, MENA, Asia and HIPC’s have a positive and significant impact on poverty levels where it increases poverty by 7%,7.7%,and 3.7% respectively. While the GM method resulted in positive and significant impacts for MENA, Sub-Saharan Africa , Asia, Central America and HIPC’s. Poverty increases by 97%, 91%, 92% and 1% respectively.

In order to investigate the role of governance between poverty and the environment a general formulation has been built in a way that it takes into account the role of HD dimensions, globalization and the environment (Costantini & Monni, 2008).

$$\text{PCA\_Gov} = \text{CO}_2 + \text{Health} + \text{Sch\_enrol} + \text{GDP} + \text{Investment} + \text{Inflation} + \text{Aid} + \text{FDI} \quad (2)$$

PCA\_Gov is a proxy for institutional quality and is a weighted average of six measures of governance adopted by Kaufman et al. (2008). Governance (PCA\_Gov ) is calculated by using principal component analysis<sup>2</sup>.

The cross–section results from the GLS and GM methods are consistent with the literature as reported in **Table (2)** . CO<sub>2</sub> emissions have significant and negative impacts on governance. The HD dimension (health & primary school enrollment) has a positive and significant impact on governance as well as GDP and investement. This provides an evidence for the crucial role played by human capital in aiding the quality of institutions. It is worth noting that FDI postively affects governance. Inflation has a negative affect on the governance level in developing countries. Foreign aid does not significantly impact governance levels according to the GLS method.

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<sup>2</sup> Before using these indicators in the empirical model, pair-wise correlation analysis was applied. The result shows strong significant correlations which in turn can cause a multicollinearity problem. In order to overcome this strong correlation between these measures, principle component analysis (PCA) was implemented. This method is applied to overcome the multicollinearity when all the governance indicators are used in the adopted model

But the group mean method results in a positive and significant impact for foreign aid on governance. The cross-country analysis results obtained from the GLS produces insignificant dummy regions except for the HIPC' while the GM method provides significant and negative impacts for MENA, Asia, Central America, Latin America and the HIPC's.

## II) The Environmental Kuznets Curve and Un-sustainability

The opposite relationship between human poverty and environmental quality has been analysed through the so-called environmental kuznets curve (EKC). Earlier contributions focused on the role of income per capita as a main cause of environmental degradation using cross-country relationships (see Grossman and Krueger, 1995; Shafik 1994) where as recent researches have tested the impact of human development (in terms of HDI ) on aspects of environmental degradation (Hill & Magnani, 2002; Tisdell, 2001).

$$\text{CO2} = \text{HPI} + \text{HPI}^2 + \text{HPI}^3 + \text{PCA\_gov\_2} + \text{M\_trade} + \text{Ratio\_Sec} + \text{Health} \quad (3)$$

In this study, CO2 is used as a dependent variable and a proxy for environmental degradation due to availability of data. HPI and its cubic term are used to improve the estimates. Female secondary enrollment, merchandise trade (as % of GDP) and public expenditure on health (as % of GDP) are among the explanatory variables. Principal component analysis is used to construct the governance indicator (PCA\_Gov\_2) from only two measures: rule of law (RL) and voice accountability (VC) .

The cross section results obtained from the GM regression provide evidence for the existence of an inverse N-shaped relation between poverty and polluting emissions (CO2) as reported in **Table (3)**. This is supported by the work of Grossman & Krueger 2003 who analysed the N shaped relation between income per capita and emissions with the EKC equation including a cubic term. Also, it is suggested by the work of Birget Freidel & Getzner (2003) and Martinez –Zarzoao and Bengochea –Morancho (2003).

Merchandise trade as % of GDP positively affects polluting emissions. Chichilnisky (1994) and Suri & Chopman (1998) argue that trade openness increases pollution emissions particularly for developing countries due to the delocalization of polluting industries (see also Copeland & Taylor, 2004).

Secondary enrollment as one of the HD dimensions is negatively affected by pollution emissions. As people get more educated and richer they become more concerned about the environment and thus exert pressure on politicians to introduce environmental regulations and on firms to use technologies friendly to the environment (Antle & Heidebrink, 1995). It is worth noting that the governance coefficient is positive which means that, other things equal, when governance increases pollution increases. This result is somewhat counterintuitive. One possible explanation is that in developing countries property rights over environmental resources are less well defined (Chichilnisky, 1994). Another explanation argues that dirty industries move to poor countries due to laxer environmental regulations which in turn worsens the effect of industrial goods that are intensive in labour and natural resources.

The cross-section results obtained from the GLS give insignificant effects for the quadratic and cubic term of the HP and governance variables. On the other hand the HD dimension (Health) has a significant and negative impact on pollution emissions. Also, trade openness has a positive impact on CO<sub>2</sub> emissions.

The main reason for splitting the panel data set into regional groupings is to compare the direction for each region over time. Cross-country results obtained from the GM regression support the inverse N-shaped relation between poverty and pollution emissions. Trade openness and governance variables are significant and positive while health is significant and negative.

All regional dummies are positive except for HIPC's which are negative. MENA increases pollution emissions by 12%, Sub-Saharan Africa by 12.5%, Asia by 12%, Central America 13% and Latin America by 8.5%. The results from the GLS found that Latin America, Asia, Sub-Saharan Africa and MENA are insignificant. Central America is significant and increases pollution emissions by 2% while HIPC's is negative. The human poverty index and its cubic term are insignificant. Governance surplus decreases polluting emissions and trade openness increases CO<sub>2</sub> emissions.

### 3.2) *Integrated model of poverty, governance and sustainability*

The full model specification for the adopted systems of equations may be described as follows:

$$\text{Human Poverty} = B_1 \text{CO}_2 + B_2 \text{CO}_2^2 + B_3 \text{CO}_2^3 + B_4 \text{GDP\_HDI} + B_5 \text{RL} + B_6 \text{GE} + B_7 \text{Ratio\_Sec} + B_8 \text{Life\_T} + B_9 \text{Aid} + B_{10} \text{Health} + B_{11} \text{Regional variables} \quad \text{equation (1)}$$

$$\text{Governance} = B_1 \text{CO}_2 + B_2 \text{GDP} + B_3 \text{Health} + B_4 \text{GDP} + B_5 \text{Investment} + B_6 \text{Inflation} + B_7 \text{FDI} + B_8 \text{Regional variables} \quad \text{equation (2)}$$

$$\text{Sustainability} = B_1 \text{HPI} + B_2 \text{HPI}^2 + B_3 \text{HPI}^3 + B_4 \text{RL} + B_5 \text{GE} + B_6 \text{M\_Trade} + B_7 \text{Health} + B_8 \text{Regional variables} \quad \text{equation (3)}$$

The general formulation of the poverty conceptual model is represented by equation (1) and is adopted by Arimah 2004 followed by equation 2 for governance and finally equation 3 represents the EKC model. The human poverty model is measured by the human poverty index (HPI) as a dependent variable which was first introduced by the UNDP in 1997 and seeks to represent the multidimensional nature of poverty within a single index. In addition to other explanatory variables expanding human capabilities especially education and health as well as governance and environment. Institutional quality is measured by the average of six indicators of governance provided by Kaufman et al (2008) using principal component analysis. The governance indicator is a function of variables that was used before in growth models taking into consideration HD variables and regional effects. The final equation describes unsustainability measured by the natural logarithm of metric tons of carbon dioxide emissions<sup>3</sup> (CO<sub>2</sub>) per capita as a dependent variable with independent variables of foreign direct investment, merchandize trade, rule of law, government effectiveness, health and HPI. Carbon dioxide emissions are used as a measure of environmental quality because of its data availability and it is the most used indicator in the EKC literature.

Three equations are estimated using 2SLS and 3SLS. The Hausman test was used to investigate which method of estimation provides consistent and efficient estimators. Results of this test show

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<sup>3</sup> Using the logarithmic transformation of the dependent variable to reduce the amount of skewness in the data

that 2SLS techniques is an enhancement over 3SLS. This supports the existence of an interlocking relation between poverty, environmental degradation and governance. The estimates based on cross-country data from 1996 to 2008 are reported in the *Table (4)*:

The three estimated models are significant. GDP is dropped from the poverty model because it is one of the components of the HPI causing multicollinearity. Public expenditure on health is dropped also because it is insignificant.

The female secondary enrollment ratio and foreign aid are dropped from the governance model because they are jointly insignificant. FDI and investment are dropped from the environmental degradation model because they are jointly insignificant.

More generally the output obtained from the integrated model is not far from the results obtained from independent estimates provided by the GLS and GM regressions. The role of *globalization* is positive in terms of FDI and merchandise trade as (% of GDP). FDI is positively impacting the governance level in developing countries and merchandise trade stimulates environmental degradation.

On the contrary the impact of *human capital accumulation* is quite clear and known. Human capital is measured by three variables: life expectancy at birth 1990, public expenditure on health (as % of GDP) and female secondary enrollment ratio. It is worth noting that higher human capital accumulation corresponds to a positive effect on governance and an indirect effect on poverty and environmental degradation. This explanation is adopted by Costantini and Monni (2008) who argue that improvements in HD dimensions and income per capita are first accompanied by further pollution as the industrialization process requires high output from heavy industries in the earlier stage of development. Then with the help of better institutions and qualified human resources, the industrialization process moves towards the service sector which produces less pollution emissions and thus improves environmental conservation. For *commitment to human development* (GDP\_HDI) this variable positively impacts on poverty levels in developing countries.

Both *rule of law and government effectiveness* are governance indicators adopted by Kaufman et al (2003) but they suffer from endogeneity problems. Due to this problem rule of law is significant but

carries the wrong sign in equation (1) but government effectiveness negatively impacts poverty. The same problem arises in equation (3) where rule of law indirectly impacts CO<sub>2</sub> emissions while GE carries the wrong sign. *Inflation* has a negative and significant impact on the governance indicator.

*Human poverty index and its cubic term* are used in the environmental degradation equation and are significant and the sign of the coefficients match with theory. The results support the existence of an inverse N-shaped relation between poverty and environmental degradation. Simultaneous equations suggest the downward spiral relation between poverty and environmental degradation with the lack of institutional quality.

The introduction of regional dummies in the integrated model was based on the work of Atkinson and Hamilton (2003). Countries were split into six regions: MENA, HIPC's, Sub-Saharan Africa, Asia, Central America and Latin America. The impact of regional dummies in the three equations support the interlocking relation between poverty, sustainability and governance given the endogeneity problem in measuring governance. This is explained as follows: all regional dummies share the same characteristics in which they are positively correlated with poverty and environmental degradation while negatively correlated with governance. The dummies have similar values of coefficients in governance while MENA and Asia have a bigger positive impact on human poverty. As for environmental degradation, Latin America has a bigger positive effect on environmental degradation.

**Table 5: Estimation for Poverty, Governance and Environment model using 2SLS**

	Poverty		Governance		Environment	
	Coefficient	T-value	Coefficient	T-value	Coefficient	T-value
CO2	-14.370***	(-16.27)	-0.0405136**	(-2.16)		
CO2 <sup>2</sup>	2.038046***	(14.28)				
CO3 <sup>3</sup>	-0.0660232***	(-13.65)				
GDP_HDI	-0.1671684***	(-10.66)				
Ratio_SEC	-0.1466652***	(-9.15)				
Aid	-2.81E-09***	(-6.06)				
Life t	-0.4667361***	(-9.57)				
RL	5.686213***	(6.79)			-0.9468645***	(-2.59)
GE	-3.865955***	(-4.05)			1.723026****	(4.57)
GDP			0.0001955***	(10.54)		
Investment			0.0551596***	(6.12)		
Health	-0.5415077***	(-4.84)	0.0893033***	(4.38)	-0.2295438***	(-4.37)
Inflation			-0.0030327***	(-6.03)		
FDI			0.0014889****	(3.92)		
HPI					-1.114851***	(-11.57)
HPI <sup>2</sup>					0.028995****	(9.1)
HPI <sup>3</sup>					-0.0002383***	(-7.57)
M_Trade					0.0076882**	(2.32)
MENA	94.10392***	(27.55)	-2.466219***	(-8.63)	14.69456***	(13.69)
Sub –Saharan	85.77399***	(2.82E+01)	-2.33695***	(-10.15)	15.3143***	(14.56)
Asia	91.69342***	(27.65)	-2.622461***	(-9.48)	15.20519***	(14.62)
Central America	86.32641***	(23.41)	-2.231783***	(-8.63)	16.52777***	(15.88)
Latin America	84.74869***	(24.67)	-2.316284***	(-9.04)	10.87344***	(12.97)
N	767		767		767	
F-statistic	1024.65***		54.28***		94.54***	
R <sup>2</sup>	0.9787		0.4409		0.5865	

Notes\*\*\*,\*\*,\* indicate statistical significance at the 99, 95 and 90 per cent level, respectively. T-ratios are in parentheses.

## **Conclusion and policy implications**

In analyzing the poverty-environment relationship, the main conclusion is the existence of an N-shaped relation between poverty and environmental degradation. Some general results are provided with regard to sustainability in the paper. *The first* result is that achieving sustainability at an early stage of development is a very difficult task. As satisfaction of basic human needs (reducing poverty) is considered the main objective while conserving the environment is a luxury in this stage. At the medium stage of development, environmental degradation is associated with high poverty levels due to inability to satisfy basic needs as well as excessive usage of natural resources. At higher levels of development it is always accompanied by poverty reduction due to transforming industrialization from polluting industries to other industries which are less harmful to the environment. *The second* result is the crucial role played by human capital accumulation in achieving sustainability. If economic growth is accompanied by large public investment in education and health with better institutional quality then these have a very strong impact on poverty reduction and sustainable development. *The third* result is the role of globalization in terms of merchandise trade and FDI. They positively impact environmental degradation as well as stimulate the governance level in developing countries that are exposed to international trade.

In conclusion, developing countries should avoid hosting dirty industries and adopt strict environmental regulations with well-defined property rights over environmental resources.

Human development accumulation in the form of better health care and higher educational levels are necessary conditions for achieving sustainability. As people become educated and concerned about the environment they can exert pressure on politicians to introduce environmental regulations and for firms to use more pollution abating technologies.

Globalization, openness to trade and FDI could be very beneficial for the environment even in developing countries. However these factors will only tend to be stronger if they are pursued in a context of modernizing institutions in a democratic manner, transform away from resource intensive economies to knowledge intensive economies and curtail the excessive usage of natural resources while reinforcing the role of human capital accumulation.

## Appendix

**Table 1- Model specification for conceptual poverty model using generalized least squares (GLS) and group mean (GM) methods**

dependent variable :HPI	GLS				GM			
	I		II		I		II	
	Coefficient	T-value	Coefficient	T-value	Coefficient	T-value	Coefficient	T-value
co2	-2.75039***	(-5.13)	-3.00884***	(-5.45)	-7.3935***	(-11.41)	-8.116***	(-12.43)
co2 <sup>2</sup>	0.1263***	(-3.35)	0.1389***	(-3.66)	0.988***	(-9.07)	1.044***	(-9.62)
co2 <sup>3</sup>	-0.00187***	(-2.65)	-0.00206***	(-2.93)	-0.0316***	(-8.38)	-0.033***	(-8.79)
GDP_HDI	-0.118***	(-6.38)	-1.19E-01	(-6.37)	-0.137***	(-9.88)	-0.1489***	(-9.09)
VC					-2.0663***	(-5.29)	-	
RL	-0.71465	(-1.49)	-1.076**	(-2.28)				
PS	0.339712	(-0.84)	-		2.42307***	-7.24	-	
GE	-		2.4606***	(-3.45)	-		-3.539***	(-3.91)
Ratio_sec	-0.01***	(-4.53)	-0.086***	(-3.98)	-0.2345***	(-15.49)	-0.20368***	(-14.39)
Life_t	-1.002***	(-16.03)	-1.005***	(-15.67)	-0.5628***	(-15.38)	-0.5782***	(-12.6)
Health	-		-		-0.5997***	(-5.24)	-0.367***	(-3.41)
Aid					-		-1.80E-09***	(-4.2)
MENA	-		7.32452**	(-2.59)			97.67***	(-28.18)
Sub-Saharan	-		-		-		91.09***	(-29.37)
Asia	-		7.7043***	(-3.62)	-		96.15***	(-29.75)
Central America	-		-		-		92.013***	(-25.11)
HIDC's	-		3.754**	-1.97			1.235*	(-1.85)
_Cons	101.8***	(-27.06)	98.7***	(22.01)	93.573***	(42.56)	-	
N	767		767		767		767	
Wald	719.83***		830.2***		-		-	
F-statistic	-		-		645.28***		2433.36***	
R <sup>2</sup>	-		-		0.8951		0.9811	

Notes\*\*\*,\*\*,\* indicate statistical significance at the 99, 95 and 90 per cent level, respectively. T-ratios are in parentheses. The dependent variable is Human poverty index (HPI).Functional forms were selected using the adjusted R-square criterion. In all cases the cubic form was preferred. ( I )represents cross section analysis while (II) represents country grouping analysis.

**Table 2- Model specification for governance model using generalized least squares (GLS) and group mean (GM) methods**

Dependent variable	GLS				GM			
	I		II		I		II	
	Coefficient	T-value	Coefficient	T-value	Coefficient	T-value	Coefficient	T-value
co2	-0.08034**	(-2.18)	0.2551998**	(-2.36)	-0.048***	(-2.95)	-0.036*	(-1.79)
co2 <sup>2</sup>	-		-0.01555**	(-2.29)				
co2 <sup>3</sup>	-		0.0002401**	(-1.94)				
Health	0.0632**	(-2.12)	0.058**	(-1.97)	1.01E-01***	(-5.03)	0.0891***	(-4.38)
Sch_Enrol	0.006***	(2.75)	0.0053**	(2.54)				
GDP	0.0001***	(-2.88)	-		0.00023***	(-14.27)	0.000195***	(-8.08)
Investment	0.0119**	(-2.58)	0.01159**	(-2.53)	0.03855***	(-4.83)	0.05320***	(-5.85)
Inflation	-0.0002***	(-1.51)	-0.0002***	(-1.67)	-0.0029***	(-5.99)	-0.00334***	(-6.36)
Aid	1.05E-10	(-1.32)	1.44E-10**	(-1.82)	2.12E-10***	(-2.65)	2.80E-10***	(-3.42)
FDI					0.00172****	(-5.21)	0.0016****	(-4.19)
MENA	-		-0.122876	(-0.11)	-		-2.4816***	(-8.44)
Sub-Saharan	-		-0.40559	(-0.48)	-		-2.2897***	(-8.85)
Asia	-		-1.369394	(-1.51)	-		-2.834***	(-10)
Central America	-		-		-		-2.247***	(-8.36)
Latin America	-		0.2551836	(-0.3)	-		-2.334***	(-8.4)
HIPC's	-		-1.246**	(-1.99)	-		-0.2449**	(1.96)
_Cons	-1.421***	(-4.4)	-0.457925	(-0.59)	-2.3067***	(-10.1)	-	
N	767		767		767		767	
F-statistic					85.14***		47.73***	
R <sup>2</sup>					0.4399		0.4515	
Wald	50.69***		68.62***					

Notes\*\*\*, \*\*, \* indicates statistical significance at the 99, 95 and 90 per cent level respectively. T-ratios are in parentheses. The dependent variable is the overall governance indicator which is obtained by principal component analysis (PCA\_Gov). (I) represents cross section analysis while (II) represents country grouping analysis.

**Table 3- Model specification for EKC model using generalized least squares (GLS) and group mean (GM) methods**

Dependent variable : (CO <sub>2</sub> )	GLS (Log_CO <sub>2</sub> )				GM (CO <sub>2</sub> )			
	I		II		I		II	
	Coefficient	T-value	Coefficient	T-value	Coefficient	T-value	Coefficient	T-value
<b>Hpi</b>	-0.0188*	(-1.79)	-4.24E-02	(-0.92)	-0.346***	-4.65	-0.7914***	-10.3
<b>hpi2</b>	0.000213	-0.63	0.0005322	-0.36	0.0075***	-2.86	0.0185***	-7.17
<b>hpi3</b>	-0.0000013	(-0.39)	-		-0.0001***	(-2.25)	-0.00014***	(-5.4)
<b>pca_gov_2</b>	0.021751	-1.3	-0.1645**	(-2.27)	0.4551***	-5.01	0.3108***	-3.73
<b>M_trade</b>	0.004***	-5.58	0.008***	-2.75	0.0238***	-7.26	0.0095***	-2.9
<b>Ratio_sec</b>	-		-		-0.0244***	-3.78	-	
<b>Health</b>	-0.044***	(-4.58)	-		-		-0.1756***	(-3.38)
<b>MENA</b>	-		-		-		11.89***	-12.72
<b>Sub -Saharan</b>	-		-		-		12.36***	-13.29
<b>Asia</b>	-		-		-		11.932***	-13.17
<b>Central America</b>	-		2.6402**	-2.25	-		13.18***	-14.47
<b>Latin America</b>	-		-		-		8.29***	-11.24
<b>HIPC's</b>	-		-1.985***	(-2.71)	-		-0.4760*	(-1.85)
<b>_Cons</b>	-0.05089	-0.31	2.54***	3.82	7.4448***	7.88	-	
<b>N</b>	767		767		767		767	
<b>Wald</b>	107.5***		37.67***					
<b>F-statistic</b>	-		-		66.11***		89.47***	
<b>R<sup>2</sup></b>	-		-		33.78		0.5871	

Notes\*\*\*,\*\*,\* indicates statistical significance at the 99, 95 and 90 per cent level respectively. T-ratios are in parentheses. The dependent variable is CO<sub>2</sub> emissions as proxy for environment degradation (HPI). Functional forms were selected using the adjusted R-square criterion. In all cases the cubic form was preferred. (I) represents cross section analysis while ( II) represents country grouping analysis.

**Table (5)- Descriptive statistics**

<b>Variable Name</b>	<b>Variable description</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
MENA	Dummy variables for MENA region	0.0677966	0.251561	0	1
Sub_Saharan	Dummy variables for Sub_Saharan region	0.4915254	0.500254	0	1
Asia	Dummy variables for the Asia	0.1525424	0.35978	0	1
Central America	Dummy variables for the Central America	0.1016949	0.302444	0	1
Latin America	Dummy variables for the Latin America	0.1864407	0.389716	0	1
Highly Indebted poor Countries(HIP C'S)	Dummy variables for the Highly Indebted Countries	0.4237288	0.494471	0	1
HPI	Human Poverty Index (HPI)	28.93136	16.34615	2.4	65.97
GDP__HDI	Commitment to Human Development	-5.144876	18.33954	-73.75	30.75
Edu	Public spending on education , Total (%GDP)	4.139189	2.936363	0.64	46.3
Ratio_Secondary Enrollment	Female educational enrollment	88.58743	20.56984	2.99	138.88
Health	Health Expenditure ,Public (% GDP)	5.757385	1.963569	1.88	14.28
Aid	Foreign aid	5.77E+08	5.80E+08	-3.66E+08	3.37E+09
HIV	HIV/AIDS	3.240743	5.623039	0	26.6
CC	Control of Corruption	-0.4157366	0.586329	-2.22	1.51

RL	Rule of Law	-0.4230248	0.600552	-2.11	1.28
VC	Voice Accountability	-0.3602868	0.745099	-2.2	1.21
PS	Political Stability	-0.4581356	0.836187	-3.07	1.06
GE	Government Effectiveness	-0.4009126	0.593068	-1.89	1.39
RQ	Regulatory Quality	-0.2814602	0.645643	-2.56	1.58
co2	Emissions of CO2	1.71893	3.246211	0.023	37.393
sch_en~l	Primary School enrollment, Total	99.34488	23.11762	27.847	155.786
GDP	GDP(constant international \$) 2007	4178.734	3894.012	346.127	24080.34
m_trade	Merchandise trade (%GDP)	57.55229	30.6258	12.45	192.123
Investement	Gross fixed capital formation (%GDP)	21.42473	6.615767	-23.763	48.802
life_t	Life expectancy at birth	61.20094	10.09376	33.976	78.647
FDI	Foreign direct investment	-10.4335	158.3071	-1791.846	43.82
inflation	Inflation	17.43999	196.4972	-23.479	5399.526
pca_gov	Overall governance indicator	0.1272304	2.085394	-6.330347	6.230103
pca_go~2	Overall governance indicator using PCA of RL &VC	3.17E-10	1.288072	-3.447496	3.401214

## **Bibliography**

- Ames, B. I. (2000). *Macroeconomic Issues*. Washington: World Bank PRSP Yearbook.
- Antle, J., & Heidebrink, G. (1995). Environment and Development :Theory and International Evidence. *Economic Development and Cultural Change* , 43, 603-625.
- Arimah, B. (2004). Poverty Reduction and Human Development In Africa . *Journal of Human Development* , 5 (3).
- Asadi, A. A. (2008). Poverty Allevation and Sustainable Development : The role of social capital. *Journal of Social Sciences* , 4 (3), 202-215.
- Baland, J., & Platteau, J. (1996). *Halting Degradation of Natural Resources*. Oxford: Clarendon Press.
- Bartelmus, P. (1986). *Environment and Development* . London: Allen &Unwin .
- Birgit Friedl, B., & Getzner, M. (2003). Determinants of CO2 emissions in a small open economy. *Ecological Economics* , 45, 133-148.
- Briggs, D., Corvaldn, C., & Nurminen, M. (1996). *Linkage Methods for Environment and Health Analysis: General Guidelines*. Geneva: World Health Organization.
- Bromley, D. (1991). *Environment and Economy: Property Rights and Public Policy*. Washington: Basil Blackwel.
- Bruno, M. R. (1998). Equity and Growth in Developing Countries :Old and New Prespectives on Policy Issues. In V. a. Tanzi, *Income Distribution and High Quality Growth* ((eds.) ed.). Cambridge, United Kingdom: MIT Press.
- Chichilnisky, G. (1994). North-South Trade and the Global Environment. *American Economic Review* , 84 (4), 851-874.
- Copeland, B., & Taylor, M. (2004). Trade,growth and the environment. *Journal of Economic Literature* , 1, 7-71.
- Costantini, V., & Monni, S. (2008). Environment, human development and economic growth . *Ecological Economics* , 867-880.
- Current, D. L. (1995.). Adoption of agroforestry. In D. L. Current, *Costs, Benefits and Farmer Adoption of Agroforestry: Project Experience in Central America and the Caribbean,World Bank Environment Paper No. 14*. (pp. 1–27.). Washington: The World Bank.
- Dampier, W. (1982). Ten years after stockholm :A decade of environmental debate. *Ambio* , 11 (4), 215-231.

- De Janvry, A. F. (1991). Peasant household behavior with missing market: Some paradoxes explained. *The Economic Journal* , 101, 1400–1417.
- Dollar, D. K. (2002). Growth is Good for the Poor. *Journal of Economic Growth* , 7 (3), 195-225.
- Duraiappah, A. K. (1998). Poverty and environmental degradation: A review and analysis of the nexus. *World Development* , 26 (12), 2169-2179.
- Forsyth, T. (1998). The politics of environmental health: suspected industrial poisoning in Thailand. In P. a. Hirsh, *The politics of environment in Southeast Asia : resources and resistance* (pp. 210-226). London: Routledge.
- Grossman, G. M., & Krueger, A. B. (1995). Economic growth and the environment. *Quarterly Journal of Economics* , 1, 353-377.
- Grossman, Gene, M., Krueger, & B., A. (1996). The inverted- U : What does it mean ? *Environment and Development Economics* , 1 (1), 119-122.
- Hill, R., & Magnani, E. (2002). An exploration of the conceptual and empirical basis of the environment kuznets curve. *Australian Economic Papers* , 41 (2), 239-254.
- Jalal, K. (1993). Sustainable development, environment and poverty nexus. *Asian development bank* ( occasional paper No.7).
- Jenkins, R. G. (2005). Reinventing Accountability: Making Democracy Work For Human Development. *International Political Economy Series* .
- Kaufman, D., Kraay, A., & Mastruzzi. (2008). *Governance Matters VII: Aggregate and Individual Governance Indicators 1996-2007*. Washington, DC: World Bank.
- Lazarova, E. (2006). Governance In Relation To Infant Mortality: Evidence From Around The World. *Annals of Public and Cooperative Economics* , 77 (3), 385-394.
- Lazarova, E., & Mosca, I. (2008). Does Governance Matter For Aggregate Health Capital ? *Applied Economics Letters* , 15, 199-202.
- Lele, S. (1991). Sustainable development : A critical review. *World Development* (19), 607-621.
- Martinez-Zarzoa, I., & Bengochea-Morancho, A. (2003). Testing for an environmental kuznets curve in Latin-American countries. *Revista de Analisis Economico* , 18 (1), 3-26.
- Meadows, D., Meadows, D., Randers, J., & Behrens III, W. (1972). *The Limits to Growth*. New York: Universe Books.
- Meinzen-Dick, R. B. (1997). Gender, property rights, and natural resources. *World Development* , 25 ((8)), 1303–1315.

- Otsuka, K., & Quisumbing, A. (1998). *Gender and forest resource management: a synthesis of case studies in Ghana and Sumatra*. Washington, Mimeo: International Food Policy Research Institute.
- Paragariya, A. (2002). Poverty, Inequality and Trade Openness. *ABCDE Conference*. Oslo: WorldBank.
- Park, H. M. (2009). *Linear Regression Models for Panel Data Using SAS, Stata, LIMDEP, and SPSS*. Indiana: The University Information Technology Services (UITS), Center for Statistical and Mathematical Computing, Indiana University.
- Quibria. (2006). Does Governance Matter ? Yes , No Or Maybe: Some Evidence From Developing Asia. *Kyklos* , 59 (1), 99-114.
- Ravallion, M. (2001). Growth, Inequality and Poverty : Beyond Averages. *World Development* , 29 (11), 1803-1815.
- Reardon, T., & Vosti, S. (1992). Issues in the analysis of the effects of policy on conservation and productivity at the household level in developing countries. *Quarterly Journal of International Agriculture* , 31 ( 4), 380–396.
- Scherr, S. (2000). A downward spiral ? Research evidence on the relationship between poverty and natural resource degradation. *Food Policy* , 25, 479-498.
- Sen, A. (1982). *Choice Welfare and Measurement*. Cambridge : MIT Press.
- Sen, A. (1985). *Commodities and Capabilities* . Amestrdam : North Holland.
- Sen, A. (1999). Democracy As A Universal Value. *Journal of Democracy* , 10 (3), 3-17.
- Sen, A. (1979). Personal utilities and public judgements : or what's wrong with the welfare economics. *Economic Journal* , 89 (335), 537-558.
- Shafik, N. (1994). Economic Development and environmental quality : an econometric analysis. *Oxford Economic Papers* , 757-773.
- Templeton, S., & Scherr, S. (1999). Effects of demographic and related microeconomic change on land quality in hills and mountains of developing countries. *World Development* , 27 (6), 903–918.
- Tisdell, C. (2001). Globalization and sustainability : environmental kuznets curve and the WTO. *Ecological Economics* , 39, 185-196.
- Tolba, M. (1984b). *Sustainable development in a development economy*. International Institute. Nairobi: United Nation Environment Programme.
- UNDP. (1997b). *Governance for Sustainable Human Development*. New York: UNDP.

Veit, P. M.-A. (1995). *Lessons from the Ground Up: African Development That Works.* , . Washington: World Resources Institute.

Vosti, S. R. (1997). *Sustainability, Growth and Poverty Alleviation: A Policy and Agroecological Perspective.* Baltimore, MD.: Johns Hopkins University Press.

WCED, W. C. (1987). *Our Common Future.* New York: Oxford University Press.

White, T., & Runge, C. (1994). Common property and collective action: lessons from cooperative watershedmanagement in Haiti. 43 (1),. *Economic Development and Cultural Change* , 27 (6), 1–41.

World Bank. (1997). *Taking Action to Reduce Poverty in Sub-Saharan Africa ?* Washington,DC: World Bank.

WorldBank. (1998). *Partnership for development : Proposed Action for the World Bank.* Washington,DC: World Bank.