Master thesis for the Master of Philosophy Degree in Environmental and Development Economics

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MEASURING THE EFFICACY OF SUSTAINABLE DEVELOPMENT ASSISTANCE ON ENVIRONMENTAL QUALITY: THE SUB-SAHARAN AFRICA EXPERIENCE

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DEDICATION

This dissertation is dedicated to my mother, Reckenia Pindiriri, and my father, Elias Chigora Pindiriri.

ABSTRACT

The world is facing environmental challenges in particular the surging growth of greenhouse gases emissions. In line with these challenges, the developed world is funding sustainable development in poor countries, assumed to have low willingness to pay for environmental quality improvements. We are therefore directed to asking the question, "Does financial sustainable development assistance improve environmental air quality in poor countries and if so, by what magnitude?" The study attempts to expose whether financial development assistance reduces greenhouse gases emissions in Sub-Sahara Africa or not. With regards to value addition to this field, the study attempts to introduce the consumer theory of utility maximization in explaining how financial sustainable development assistance shifts the country's optimal consumption levels and it also attempts to introduce the Marshallian productivity theory in its suggested post-cure financial sustainable development assistance model. Empirically, the study makes use of an econometric programme, STATA 9, to estimate the random effects panel data model in three functional forms, linear, quadratic and cubic forms, linking greenhouse gases emissions to sustainable development assistance, per capita income, energy use and manufacturing share. In addition, it also estimates the dynamic panel data model, linking the current greenhouse gases emissions to previous emissions in SSA countries.

The study finds no evidence that financial sustainable development assistance improves environmental air quality in SSA. The findings provide evidence that the quadratic functional form in terms of the sustainable development assistance variable provides the best fit for SSA data whereas the cubic functional form has the worst fit. While the explicit link between environmental quality and per capita income professed by various empirical studies is not refuted, this study finds evidence that increases in current per capita incomes increase greenhouse gases emissions in SSA. In addition, energy use and manufacturing share are found to be significant determinants of variations in greenhouse gases emissions in SSA in both the linear and quadratic functional forms. But in the dynamic random effects estimation, the study finds no evidence of a significant influence of previous greenhouse gases emissions on current emissions although there is an indication of a positive relationship.

LIST OF ABBREVIATIONS

CDM:	Clean Development Mechanism
CFSEA:	Carbon Finance for Sustainable Energy in Africa
DAC:	Development Assistance Committee
ENUSEPGDP:	Energy Use as a share of output
EU:	European Union
FE:	Fixed Effects
FfD:	Financing for Development
FGLS:	Feasible Generalized Least Squares
GDP:	Gross Domestic Product
GDPPCAP:	Gross Domestic Product per capita
GHGEM:	Greenhouse Gases Emissions
GHGEMPGDP:	Greenhouse Gases Emissions per unit of output
GLS:	Generalized Least Squares
IDA:	International Development Association
IFC:	International Finance Corporation
LSDV:	Least Squares Dummy Variables
MANSHARE:	Manufacturing share
MIGA:	Multilateral Investment Guarantee Agency
MVLUE:	Minimum Variance Linear Unbiased Estimator
NEAPS:	National Environmental Action Plans
NGOs:	Non-Governmental Organizations
ODA:	Official Development Assistance
OECD:	Organization for Economic Cooperation and Development
OLS:	Ordinary Least Squares
RE:	Random Effects
SDA:	Sustainable Development Assistance
SDAPGDP:	Sustainable Development Assistance per unit of output
SSA:	Sub-Sahara Africa
UN:	United Nations
UNDESA:	UN Department of Economic and Social Affairs
UNDP:	United Nations Development Programme
UNEP:	United Nations Environmental Programme
UNFCCC:	United Nations Framework Convention on Climate Change
US:	United States
WBDIS:	World Bank Development Indicators Statistics
WSSD:	World Summit on Sustainable Development
WTP:	Willingness to Pay

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CHAPTER 1

OVERVIEW OF THE STUDY

1.1 INTRODUCTION

Global warming has become the major challenge of the world today. Average global temperatures are rising to unprecedented levels due to unsustainable burning of fossils in production, with some countries experiencing deaths from heat waves. Human economic activities that emit greenhouse gases are behind the deterioration of the environmental quality. The United Nations Environmental Programme (UNEP)'s annual report (2007) reports that the United Nations (UN) has convened several conferences to discuss the challenge of climate change. In 2002, several nations met in Kyoto, Japan and launched the Kyoto Protocol, which sets international standards for reducing global greenhouse gases emissions levels. The Kyoto Protocol expires in 2012 and in December 2007, countries converged in Bali, Indonesia for the UN Framework Convention on Climate Change (UNFCCC) conference, which launched international negotiations to draft a successor treaty to Kyoto Protocol. The Bali conference created the road map, which commits nations to negotiating a new climate change treaty by 2009.

Of all the greenhouse gases, carbon dioxide (CO_2) has the greatest share of the globe's total emissions. According to World Bank Development Indicators Statistics (WBDIS, 2007), in 2000 the share of CO_2 was 74% comprising of 55% from fuel and cement production and 19% from land use change and forestry. The other 26% share was from nitrous oxide (9%), methane (16%) and other gases (1%). Global emissions of greenhouse gases have rapidly increased over the years, from a total of less than two billion metric tons in 1950 to over six billion metric tons in 2004 as reported in WBDIS (2006).

Euro Statistics (2008) indicate that in Western Europe, four countries namely United Kingdom, Germany, Italy and Spain are among the top 20 national fossil fuel CO_2

emitters. In 2004, North America comprising of the United States (US) and Canada was the highest fossil fuel CO_2 emitting region of the world with 1.82 billion tons of carbon as reported by WBDIS (2007). It was a 1.6% increase from the 2003 figure. But because of rapid growth in other economies like China, emissions from North America have shrunk from 46.4% of the global total in 1950 to 24.3% in 2004. The WBDIS (2007) further reports that the second world economies, like China have experienced rapid growth in green house gases emissions. Growth in CO_2 emissions in China was virtually continuous until 1996 as the Centrally Planned Asia's contribution rose from 1.4% of the world total emissions in 1950 to 15.6% in 1996.

Unlike in developed countries and second world economies, the WBDIS (2007) show that Africa's fossil fuel CO_2 emissions are low in both absolute and per capita terms. Total emissions for Africa have increased 12.1 fold since 1950 reaching 314 million metric tons of carbon in 2004, but still less than the emissions of some single nations including the US, China, Japan, among others. Emissions from all fuel sources have grown in the African region over time with liquid fuels accounting for 44%, solid fuels accounting for 34.2%, and gas fuels accounting for 12.4%. South Africa alone accounts for 38% of the total continental emissions from fossil fuels and cement production.

The general consensus in most poor countries is that they should not be too concerned about greenhouse gases emissions while their populations are starving. Their economies are still poor to the extent that fuel and cement production (CO_2 emitting processes) are considered essential for rapid economic growth. These economies also argue that though their total emissions are growing, they still make an insignificant share of the world's total. On the basis of this reasoning, developing countries have been so reluctant in devoting significant resources to fighting the surging growth of greenhouse gases emissions. However, it is feared that since developing countries will in the future reach the current Chinese phase of economic growth and the developed world phase, the environment, with the current levels of emissions, will not have the capacity to sustain life.

While the deterioration of the environmental air quality because of economic activities has become a major concern in most developed countries in particular the European Union (EU), the USA and Japan, it has not been considered as a special issue in most developing countries. Developing countries argue that they do not have enough resources to finance environmental air quality improvements given their very low output levels, insignificant world share of greenhouse gases emissions and starving populations. In the environmental economics literature (Kolstad, 2000), it is argued that the poor have very low Willingness to Pay (WTP)[1] for environmental quality improvements while the rich's WTP for environmental quality is high. Kolstad (2000) argues that the rich whose WTP is very high should compensate the poor for the incurred opportunity cost of environmental quality improvements in order to instill interest for environmental quality in the poor. In support of this argument, the flow of financial assistance for sustainable development from rich countries to poor countries has increased over the past three decades.

The United Nations Development Programme (UNDP)'s annual report of 2007 reports that by 1990 Sustainable Development Assistance (SDA) inflow to Sub-Sahara Africa (SSA) had over tripled its average of the 1970s decade. In 1990, SSA countries received a total of US$17.2 billion from SDA providers that include the World Bank, Japan's Official Development Assistance (ODA), the United States (US), Development Assistance Committee (DAC) of the Organization for Economic Co-operation and Development (OECD), United Nations, among others. Until 1999, SDA inflow trend of SSA was increasing since 1970.

In 2007, the World Bank Annual Report reports that in 1992 the Japanese fiscal authorities announced Japan's intention to substantially enhance and increase its ODA in the environmental field, in order to contribute to the realization of sustainable development. The authorities said, "Environmental issues in developing countries are critical problems because they threaten to seriously damage not only developing

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[1] Willingness to Pay (WTP) is the cost that an individual is willing to incur in order to get a unit of the required product.

countries themselves, but also the entire international community, including Japan." The country allocated 900 billion to one trillion yen for assisting environmental issues in developing countries during a five-year period from fiscal year 1992. However, over this fiscal year period, the target was exceeded by 40% as 1440 billion yen was provided.

The UNEP annual report (2007) reports that a joint UNEP-World Bank initiative, "Carbon Finance for Sustainable Energy in Africa (CFSEA)" is working with host government agencies, banks and project sponsors to develop an initial pipeline of Clean Development Mechanism (CDM) investment opportunities in Cameroon, Ghana, Mali, Mozambique and Zambia. UNEP is working with funding from Sweden, Spain and Finland to overcome barriers to the carbon market in SSA countries and enhance the capacity of the private sector to access carbon finance.

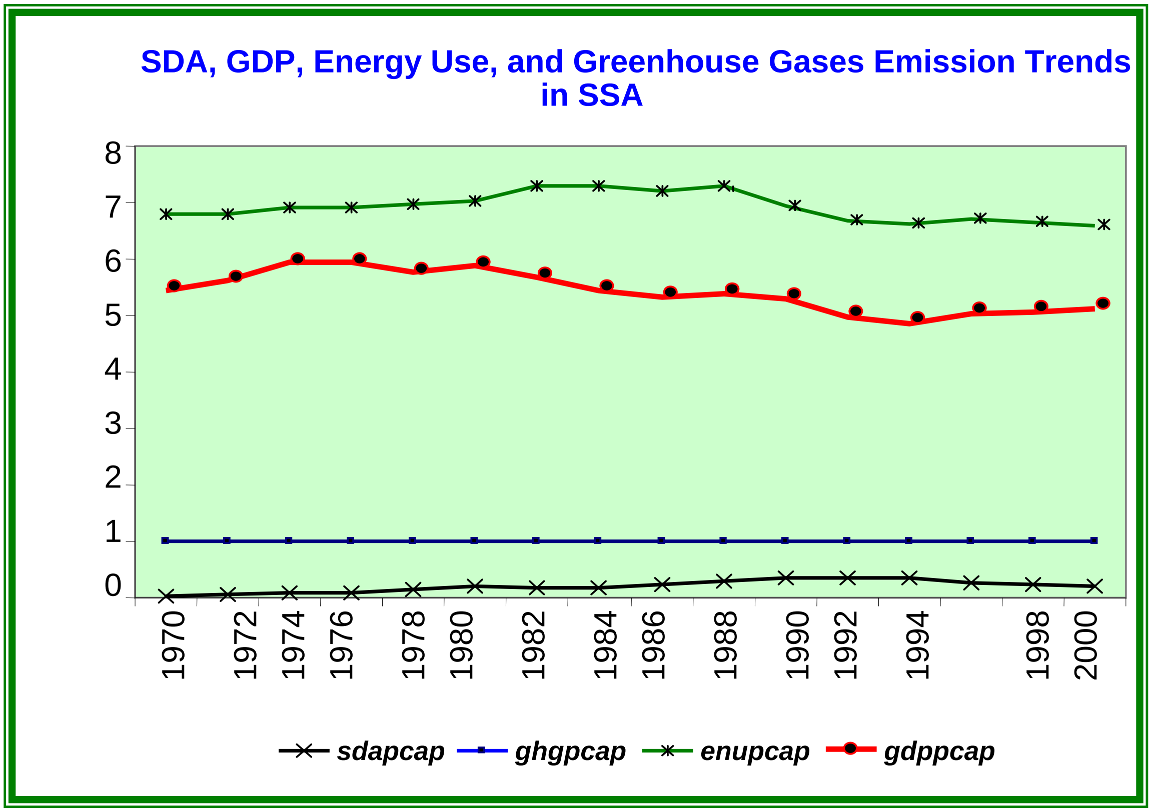
The 2007 WBDIS indicates that in 1998 ODA to SSA fell from the 1994 figure of US$18.8 billion to US$13.5 billion. Since it had the greatest share of the total SDA to SSA, its fall caused the total SDA to SSA to fall to US$12.3 billion in 1999 from the 1990 figure of US$17.2 billion, despite the fact that US aid, which is mostly humanitarian, was increasing during this period. Figure 1 illustrates that SDA per capita in SSA followed an increasing trend until the late 90s in which the trend was reversed. During the period of increasing inflow of SDA, the Gross Domestic Product (GDP) per capita was also increasing but at a very slow rate as indicated in figure 1. The graph also illustrates that during the period 1983 to 1999 in which SDA per capita was increasing rapidly, GDP per capita or economic growth failed to respond to SDA growth. In fact economic growth remained stable in most years, with unpronounced positive and negative growth rates in some years. The African Development Bank's annual report (2004) reports that over 30% of the financial SDA to SSA in the 1980s and early 90s were allocated to countries with instability like Mozambique, Rwanda, Angola, Ethiopia, Somalia, among others. The SDA was basically for humanitarian issues and failed to address investment issues in both output production and environmental technologies.

Despite the increasing total greenhouse gases emissions in SSA, figure 1 indicates that per capita emissions almost remained stable from 1970 to 2000. The reasons could be that:

- The increasing SDA inflow might have been used to avoid emissions from further increases
- SSA population could have been growing rapidly to reduce per capita emissions
- Production could have been so low in the region

A more formal derivation of the relationship between financial SDA per capita and greenhouse gases emissions per capita is applied in the succeeding chapters (see chapters 3 and 4).

Figure 1
SSA Trends in Financial SDA, Greenhouse Gases Emission, Energy Use and GDP



Financial SDA per capita and GDP per capita (gdppcap) are in 00s US$, Greenhouse gases emissions per capita (ghgpcap) in metric tons and Energy use per capita (enupcap) in 00s kgs of oil equivalent. Source: The WBDIS data.

1.2 PROBLEM STATEMENT

Economic growth is highly linked with increasing emissions of greenhouse gases. In developing countries, rapid economic growth is not an option but a need because of the starving populations. It is against this background that though every individual country should have an input in the reduction of greenhouse gases emissions through sustainable economic development, developing countries have scarce resources to pay for environmental air quality improvements. In other words, developing countries have a very low WTP for environmental air quality improvements. A holistic approach in which the rich compensate the poor for emissions reduction is therefore a prerequisite for the global fight against greenhouse gas emissions. Developed countries have since been providing sustainable development assistance to developing countries for the purpose of achieving sustainable development. However, the question is, "Does the assistance effectively influence environmental air quality in poor countries?"

1.3 OBJECTIVES OF THE STUDY

The study seeks to empirically examine the contribution of sustainable development assistance given to developing countries in improving environmental air quality. Since in this study, greenhouse gases emissions are used as a measure of environmental air quality, the study specifically investigates how the financial sustainable development assistance given to SSA has influenced its emissions over the period under study. The main questions of the study are:

- Does financial SDA influence greenhouse gases emissions in SSA region?
- For a unit change in the amount of financial SDA embodied in a unit of output, by how much will the proportion of green housegases embodied in a unit of output change?

It also investigates the impact of energy use intensity, per capita income and manufacturing share on greenhouse gases emissions in SSA.

1.4 JUSTIFICATION OF THE STUDY

The study is carried out during the period in which the world is trying to find solutions to the unsustainably rising levels of greenhouse gases emissions. In December 2007, over

180 countries met in Bali, Indonesia for a UN conference on global greenhouse-gas pollution. During this conference European countries called for the UN to set a goal of halving greenhouse-gas pollution by 2050. In addition to the urgent attention given to these emissions, developing countries have experienced an increased inflow of financial assistance for sustainable development from developed countries, particularly from European countries, the United States, the UN and Japan. It is against this background that every country should have the responsibility of improving the marginal benefit of financing sustainable development. It is important that every marginal unit of the SDA received by developing countries be used effectively in economic growth without compromising environmental air quality. The study seeks to explain whether financial SDA effectively alters greenhouse gases emissions in SSA countries. This will in turn provide some hints on the need to find better methods of financing sustainable development.

1.5 HYPOTHESES

The theoretical basis of this study is that in the absence of compensation from rich countries, poor countries devote insignificant resources to control greenhouse gases emissions because their WTP for environmental air quality improvements is very low. On the other hand, in the presence of compensation for their loss of output (the opportunity cost of environmental air quality improvements), they will devote significant resources to environmental quality. But because of the absence of perfect monitoring, it is assumed that the compensation given in the form of financial assistance such as SDA can only influence emissions weakly in these countries due to moral hazard problems. So the study tests the assertion that financial SDA negatively and weakly explains the variability of greenhouse gases emissions in developing countries. In addition, it also tests the hypothesis of a positive relationship between greenhouse gases emissions and the other explanatory variables, which include energy use intensity, per capita income, manufacturing share and the lagged variables of financial SDA and per capita income.

1.6 SCOPE OF THE STUDY

The study covers a sample of 28 SSA countries over a 31-year period from 1970 to 2000. The study considers only countries without missing data over the study period. The two dimensional model (time dimension and cross sectional or country dimension) calls for the use of panel data econometrics methodology. By applying this methodology, the study seeks to explain the effect of financial SDA on air quality variability across SSA countries over time. It focuses on whether financial SDA influences environmental air quality in SSA countries and not on the causes of the effectiveness/ineffectiveness of SDA.

1.7 ORGANIZATION OF THE PAPER

The rest of the work is organized as follows: Chapter two presents literature review. Chapter three covers theoretical framework and methodology. Model estimation and analysis of results are presented in chapter four. Finally, chapter five concludes and gives some policy recommendations.

CHAPTER 2

LITERATURE REVIEW

Empirical studies on the effectiveness of SDA have been mainly carried out by the World Bank, scholars and some of the assistance providers like Japan, Western Europe and the United States. These studies mainly concentrate on the relationship between economic growth and SDA. They are commonly deprived of the impact of SDA on the environment; what this study seeks to address.

Dollar and Pritchett (1998) argue that the World Bank's 1998 release of Assessing Aid represents a landmark attempt to quantitatively study what makes aid effective. Mounting criticisms of foreign aid from the public and private sectors set the stage for the release of Assessing Aid. The report has a heavy focus on empirical evidence that lends a scientific credibility to the work. The report uses regression models that incorporate policy, economic, and institutional index scores derived from empirical data on aid programs in 56 developing countries during 1970-93. These models form a useful and detailed analytical framework designed to isolate the factors that contribute to the success or failure of aid initiatives. The results are used to develop a series of conclusions about why aid works in some situations and not in others. Corruption has been found to be a critical factor in the failure of multiple aid programs. The report generated the following central finding: Aid does the most to support economic growth and reduce poverty when local governments practice "good management" of social, environmental, political, and economic institutions. The report's conclusions are:

- "Improvements in economic institutions and policies in the developing world are the key to a quantum leap in poverty reduction."
- "Effective foreign aid is a natural compliment to private investments."
- "Sector specific development projects are often fungible, but they can serve to strengthen local institutions and policies across sectors."
- "Projects that involve local "ownership" and social investments are most effective."

- “Aid can work even in poor policy environments if donors focus on sharing of knowledge and technical capacity rather than money.”

The World Bank report also concludes that high corruption levels in developing countries makes financial (monetary) assistance ineffective. The better option for aid could therefore be the sharing of knowledge and technical capacity.

In 2006 the World Bank assessed the effectiveness of World Bank Group Assistance (WBGA) for the environment as reported in the World Bank Development Report (2006). The environment has become central to the international development agenda over the past three decades, including that of the World Bank Group (hereafter “the Bank Group” or WBG). This began with the first United Nations Conference on the environment held in Stockholm in 1972, after which countries throughout the world began to give increasing attention to environmental concerns. Around the same time, the World Bank appointed its first environmental specialists. As part of its 1987 reorganization, the Bank established a central Environment Department and Environment Divisions in each of its four (later six) operational Regions. It also set mandatory procedures for screening, assessing and managing all new investment operations for their environmental (and social) effects, as did the International Finance Corporation (IFC) and (once established in1989) the Multilateral Investment Guarantee Agency (MIGA). In the early 1990s, any developing countries – particularly those eligible for financing from the International Development Association (IDA) elaborated National Environmental Action Plans (NEAPs), and the Bank (including IDA) began to step up lending for environmental improvement, often to support implementation of these plans.

The 2006 assessment and evaluation of the WBGA were largely based on country case studies. The assessment was on a full range of WBG support involving the environment and its effectiveness over the past decade and a half. China, India and Brazil, the most significant Bank Group clients in terms of their global environmental importance were given first priority as case studies. In Africa the evaluation focused on four countries (Ghana, Madagascar, Senegal and Uganda). In addition, two more countries considered being globally and regionally significant (Russian Federation and Egypt) were also considered as case studies. In Brazil WBGA was found to be effective in forestry conservation. In the African countries and China the WBG financial assistance insignificantly improved environmental quality whereas the non-financial assistance had a positive impact on environmental quality.

Grossman and Krueger (1993) investigate the reduced-form relationship between per capita incomes and various environmental quality indicators, urban air pollution, oxygen regime in river basins, fecal contamination of river basins, and contamination of river basins by heavy metals. They apply the random effects estimation procedure using the linear, quadratic and cubic functional forms and the findings are:

- Urban air pollution rise with per capita GDP at per capita income levels below US$10 000 at constant 1990 US$. All income variables are significant at the 1% level but lagged variables are more significant.
- Dissolved oxygen in rivers rise with per capita GDP at income levels below US$7500 but falls when this income threshold is exceeded. Income variables are jointly significant at the 1% level.
- Increases in per capita GDP are associated with roughly constant levels of fecal contamination until a country reaches a real per capita income level of US$8000. Thereafter, fecal contamination falls with income.

In their sample, Grossman and Krueger find that the cubic functional form provides the best fit for countries with per capita incomes in excess of US$16 000. In their sample of North American countries only Canada and the United States of America exceeded this income threshold. The quadratic functional form also provides the best fit for countries with per capita incomes in excess of US$8 000. They generally find no evidence that environmental quality steadily deteriorates with economic growth.

Shafik (1994) estimates three functional forms of panel regression of environmental quality on per capita income, endowment such as climate, technology, and social decisions policies for 149 countries over the period 1960 to1990. The results indicate that environmental indicators such as water quality and urban sanitation improve with higher per capita incomes whereas air pollution such as carbon emissions worsens with higher per capita incomes, during the initial phases of economic development. His log-linear specification provides the explanatory power with significant quadratic and cubic terms. The turning point on the quadratic specification occurs at per capita income levels well above US$10 000. Shafik reaches the same conclusion with Grossman and Krueger that the quadratic and cubic functional forms provide the best fits for countries with per capita real incomes well above US$10 000. Seldon and Song (1992) also find evidence that quadratic and cubic functional forms provide excellent fit for data related to developed countries, that is, to high per capita income countries.

Bourguignon and Sundberg (2007) examine aid effectiveness in developing countries. Based on the cross country regressions by Rajan and Subramanian (2005), Easterly et al (2003) and Clemens et al (2004), Bourguignon and Sundberg conclude that the relationship between aid and development outcomes is fragile and often ambiguous. Aid has often been for non-developmental objectives, such as disaster relief or for military and political ends. Much aid is lost due to instability and conflict: roughly half of aid to Sub-Saharan Africa has gone to countries facing civil war and/or frequent military coups (Fitzpatrick et al, 2007). By analyzing ninety-seven different studies on the impact of aid on growth, drawing on three different approaches used in the literature, they conclude that at best there appears to be a small positive, but insignificant, impact of aid on growth.

Najam (2002) analyzes the UN Summit on Financing for Development (FfD), whose main goal is output growth in the third world countries and the World Summit on Sustainable Development (WSSD), which put more emphasis on environmental quality than on output growth. For developing countries in particular and for all those concerned with issues of international development, the substance of these summits and the fact that they come back-to-back is of considerable significance. Arnold points out that developing countries preferred FfD to its successor WSSD which has more emphasis on environmental quality.

Burnside and Dollar (2000) found out that when other determinants of growth are controlled for, especially an indicator of economic policy, aid has no effect on growth. Aid only makes a positive contribution to growth in those countries with high values for the policy indicator; if policy is poor, aid is ineffective. After using essentially the same data for the same sample, but with different specifications and estimators, Hansen and Tarp (2001) argue that aid does have a positive effect on growth and this result is not conditional on policy.

The mechanism on how aid is transmitted into economic growth in SSA countries is discussed in Gomanee, Girma and Morrissey (2002)'s Aid and Growth: Accounting for Transmission Mechanism in SSA. They identify investment as the most significant transmission mechanism, and also consider effects of aid on growth via government spending and imports. With the use of residual generated regressors, they achieve a measure of the total effect of aid on growth, accounting for the effect via investment (see figure 2). A pooled panel results for a sample of 34 SSA countries over the period 1970 to 1997 point to a highly significant positive effect of foreign aid on growth. On average, a percentage point increase in aid-GDP ratio adds one third of a percentage point to the growth rate.

The UN Department of Economic and Social Affairs (DESA)'s working paper No. 11 examines how diverging interests among the stakeholders, the donor, the developing country government and its people might cause non-optimal allocation of SDA. In the working paper, O'Brien and Ryan (2001) reports that, "Kenya continued to violate its agreements with donors on grain marketing because those in charge of the state benefited from such an arrangement. The response of donors to government's pattern of one step forward, three steps back, sometimes deliberately ignored the point that the problem was political, related to protecting the vested interests of key actors, and not technical." Governments might thrive to satisfy their own utility at the expense of country utility thereby making the aid inefficient. Under such circumstances, Putman (1993) argues that increasing the number of non-state actors would improve the efficiency of aid. Putman's

1993 study in Italy found a statistically significant relationship between the growth of non-state organizations (NGOs) and developmental effectiveness.

DESA also explains that donors might also cause inefficiency in the allocation of aid by having interests that diverge from developing countries' interests. According to the DESA working paper No. 11, in Uganda donors assisted local groups to develop organizations to protect the environment in an area where hills were virtually denudated. These hills were of marginal interest to community members because their livelihood was mostly off-farm and did not stem from toiling their land. Hence they did not have much incentive to put their labour into environmental protection.

Empirical literature discussed in this chapter shows that most of the empirical studies on the efficacy of development assistance put more emphasis on the aid's impact on economic growth, social and political institutional development. The general consensus in these studies' conclusions is that financial aid is less effective for sustainable development in countries with poor macroeconomic policies and high levels of corruption whereas non-financial assistance such as knowledge and technology sharing prove to be effective irrespective of the country's corruption levels.

The word "sustainable" appears in almost every study but surprisingly the studies seem to give little attention to the environment. In other words the empirical studies deprive the word "sustainable development"[2] of the environmental weight it deserves. It is from this background that the idea of this study to examine the impact of financial SDA on environmental quality was generated.

Basing on Gomanee et al's argument on how aid is transmitted into growth, this study assumes that SDA can also be transmitted into environmental quality improvement through the same mechanism. This mechanism is based on the Harrod-Domar model of growth which says that developing countries have very low savings rates which makes it difficult for these countries to accumulate capital. So with additional income from

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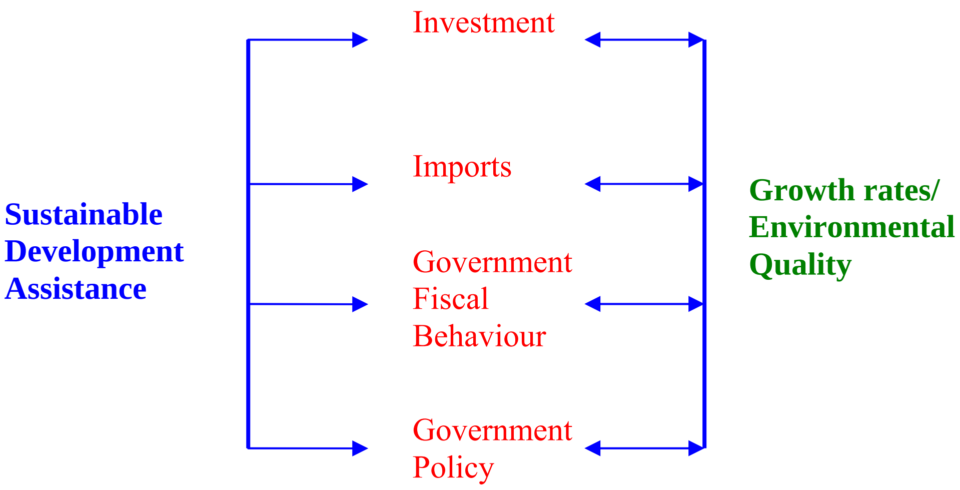
[2] Sustainable development is the development that does not compromise the ability of future generations to meet their needs.

sustainable development assistance, they can raise their saving thereby increasing investment, which in turn influences economic growth and environmental quality. Figure 2 illustrates this transmission mechanism.

Figure 2

Transmission Mechanisms for Aid to Growth/ Environmental Quality



Source: Aid and Growth: Accounting for transmission mechanisms in SSA countries by Gomanee et al (2002)

CHAPTER 3

THEORETICAL FRAMEWORK AND METHODOLOGY

3.1 THEORETICAL FRAMEWORK

Little has been said about the applicability of classical models in explaining the impact of financial sustainable development assistance on environmental quality in poor countries. There is wide agreement about the need for developed countries to assist developing countries with financial resources for the purpose of achieving the world‘s developmental goal of sustainability. There is however least agreement on whether the financial assistance is effectively used by developing countries or whether the assistance is effectively provided by the developed countries. What does economic theory say about this?

In this chapter, the linkage between economic theory and this study will be discussed. Two different theoretical frameworks will be considered in this section. The first part, 3.1.1, discusses the linkage between this study and the consumer theory of utility maximization whilst section 3.1.2 discusses the transmission mechanism of sustainable development assistance to environmental quality and growth with clean-up expenditures.

3.1.1 The Theory of Utility Maximization

This section utilizes microeconomics theory to advance the economic theoretical basis of financial assistance given to developing countries by developed countries for sustainable development. The basic tool of analysis in this paper is the consumer theory of utility maximization. When developing countries receive financial SDA from developed countries they respond by attempting to maximize their utility subject to their resource base. However, the question is: “how do these countries allocate the financial SDA to maximize their utility?” They can either finance environmental air quality improvements activities, output growth activities or both. The objective of developed countries giving sustainable development financial assistance to these countries is to finance activities that improve developing countries’ output without harming the environmental quality (Q). However, outcome expectations from developed countries might be higher than the optimal outcomes for environmental air quality in developing countries. This is explained by the low level of WTP for improvements in environmental air quality in poor countries. It is assumed that the indifference curves for poor countries are biased towards output growth whereas those of developed countries are biased towards environmental quality. In most low income countries like in SSA countries, governments strive to feed the majority poor population, a situation which could force these governments to use the cheapest means of production in order to provide affordable products to this group whose WTP for environmental air quality is very low. In the event that the government's utility is more biased towards output growth than the country's utility, the environmental quality and output outcomes from financial SDA might also be non-optimal. The inefficiency of financial SDA in developing countries might therefore be a result of:

- Developed countries demanding higher than optimal environmental quality outcomes from developing countries.
- Abuse of financial SDA by developing countries' governments which might be seeking to satisfy government utility at the expense of country utility.

The abuse of financial SDA is mainly a result of moral hazard problem. Governments of developing countries can only abuse the assistance in situations where the providers of the assistance cannot monitor the actions of the assistance-receivers. Gyimah-Brempong and Traynor (1999) argue that most low income countries like those in SSA, the political goal tends to override the goal of sustainable development. Governments of these countries strive to attract support from the majority of the population who are poor by trying to use the cheapest means of production in order to provide affordable products. So the financial sustainable development assistance received by these countries might be used to produce cheap output at whatever cost to the environment irrespective of the assistance's goal of sustainability in development.

The Optimal Choice

Developing countries derive utility from environmental quality (Q) and output (Y), that is, $U = U(Q, Y)$. It is assumed that this utility function is continuous, increasing and concave in both Q and Y, that is:

$$\frac{dU}{dQ} > 0 \qquad \frac{dU}{dY} > 0$$

$$\frac{d^2U}{dQ^2} < 0 \qquad \frac{d^2U}{dY^2} < 0$$

Each country thrives to achieve the highest possible level of utility but it is constrained by its resource availability, W. It therefore faces the following problem:

$$\max_{Q,Y} U = U(Q,Y) \ s.t \ \ p_Q Q + p_Y Y \leq W,$$

where p_Q is the per unit cost of environmental quality improvement and p_Y is the per unit cost of output production. The Lagrange multiplier is used to solve this problem of static optimization and utility is maximized when the **Marginal Rate of Substitution (MRS)**[3] between Q and Y is equal to the price ratio of the two commodities. Figure 3.1.1 (a) illustrates the optimal condition as discussed in microeconomic literature (Varian, 1992). From this diagram Q^* and Y^* are the respective environmental quality and output levels that maximize utility. However, these levels are very low in developing countries to the extent that some of these economies are characterized by very low per capita income and starving populations. Poverty levels are very high, which make governments of these countries thrive for output growth at the expense of environmental quality improvement. It is against this background that this paper assumes that in poor third world countries, with more emphasis put on the African continent, first priority is given to output growth at the expense of environmental quality improvements.

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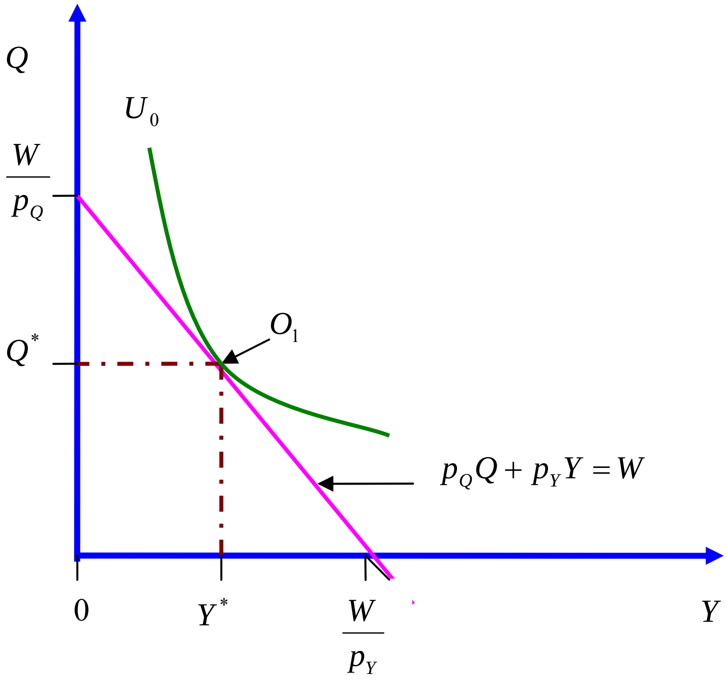
[3] The Marginal Rate of Substitution, which is the slope of the indifference curve, measures the opportunity cost of consuming one more unit of a commodity, that is, it gives the number of units of commodity A (say Y) that should be given up in order to have one unit of commodity B (say Q).

Figure 3.1.1 (a)

The Optimal Choice

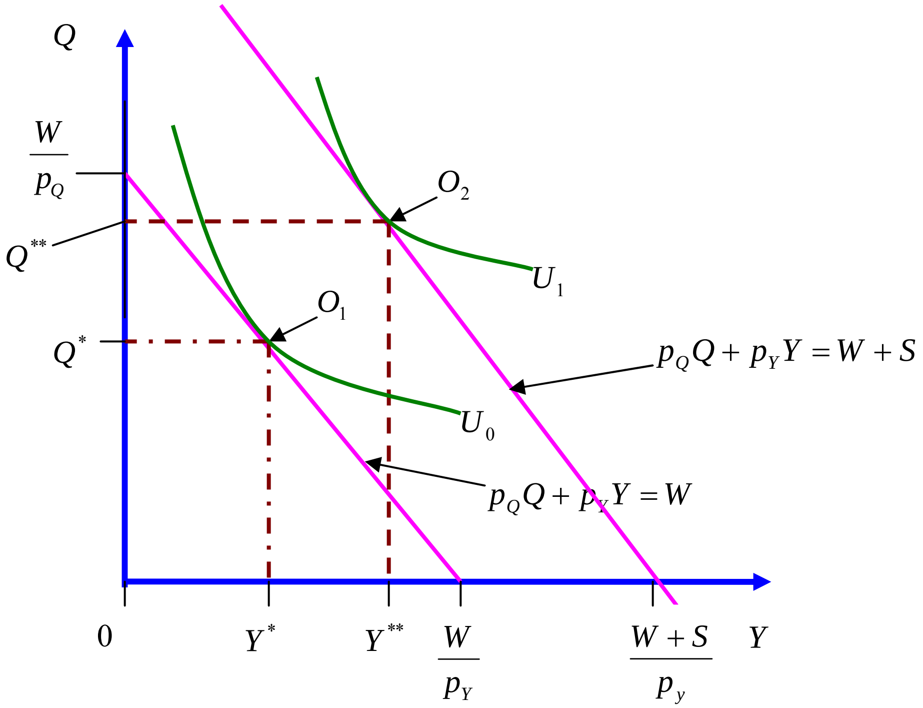


The financial assistance given to these poor countries by rich countries for sustainable development modifies the optimal choice of consumption through changes in the country's budget constraint. Such modifications are demonstrated in the succeeding sections.

Utility Maximization in the Presence of Financial SDA: A Model of Pre-Cure Environmental Financial Assistance

Pre-cure is hereby defined as "before putting any effort in environmental improvement or treatment". The financial assistance given to developing countries to finance activities that improve environmental quality before these countries take any action is therefore referred to as pre-cure assistance. When developing countries receive this financial assistance from rich countries, they can either finance environmental quality improvement activities, output growth activities or both. The financial SDA which is mostly provided as lump sum shifts the country's budget line to a higher level and establishes a new resource constraint parallel to the one illustrated in figure 3.1.1 (a). The assistance will therefore increase the country's budget thereby making higher environmental quality and output production affordable, giving higher optimal values of Q and Y. Figure 3.1.1 (b) illustrates how financial SDA shifts the resource constraint in developing countries.

Figure 3.1.1 (b)
The establishment of a new optimal level

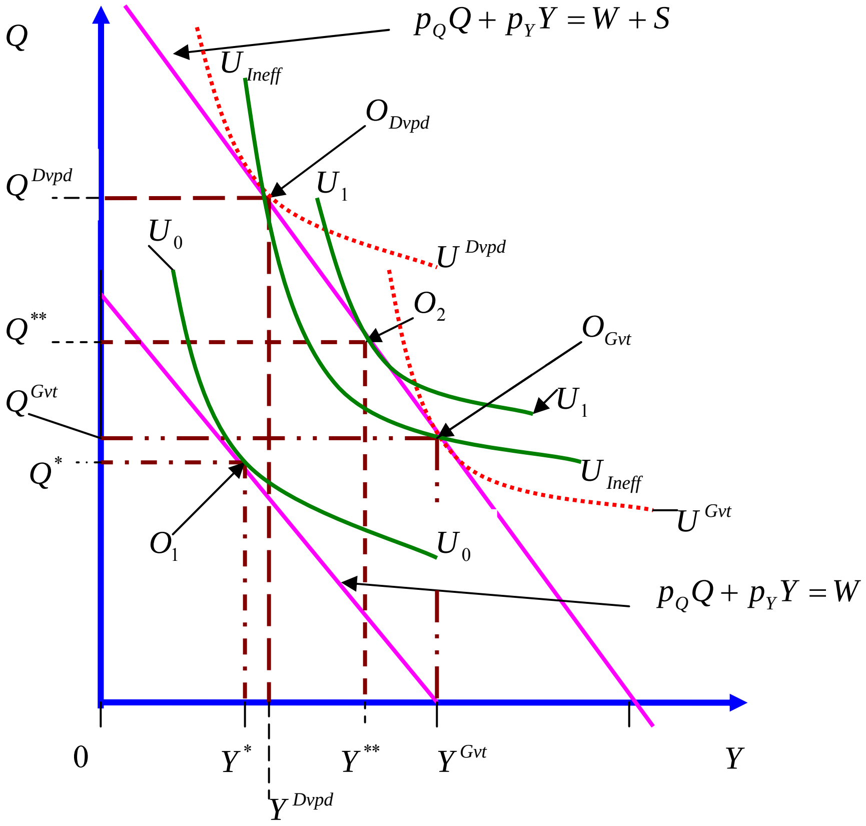


Financial SDA improves the utility of a developing country via a parallel upward shift of the budget constraint.

A lump sum financial SDA, S, shifts the country's budget constraint from $p_Q Q + p_Y Y = W$ to a higher level budget , $p_Q Q + p_Y Y = W + S$. The developing country will therefore move to a higher optimal point, O_2, with higher levels of environmental quality, Q^{**}, and output, Y^{**}, from a lower optimal point, O_1, as illustrated in figure 3.1.1 (b). It is also shown that the financial SDA makes it possible for the developing country to shift from a low utility indifference curve, U_0, to a higher utility indifference curve, U_1.

Since developed countries are assumed to have indifference curves biased towards environmental quality such as U^{Dvpd} illustrated in figure 3.1.1 (c), their expectations about the outcome of environmental air quality from the financial SDA, sometimes exceed the optimal of a poor country, that is, sometimes exceed Q^{**}. In the absence of information asymmetry and rigidities in enforcement, SDA providers can monitor and control the use of the funds. In the event that their demands for environmental air quality exceed Q^{**} such as Q^{Dvpd}, with no enforcement rigidities and no information asymmetry, financial SDA can also be inefficient in developing countries.

Figure 3.1.1 (c)
Non-optimal environmental quality and output levels



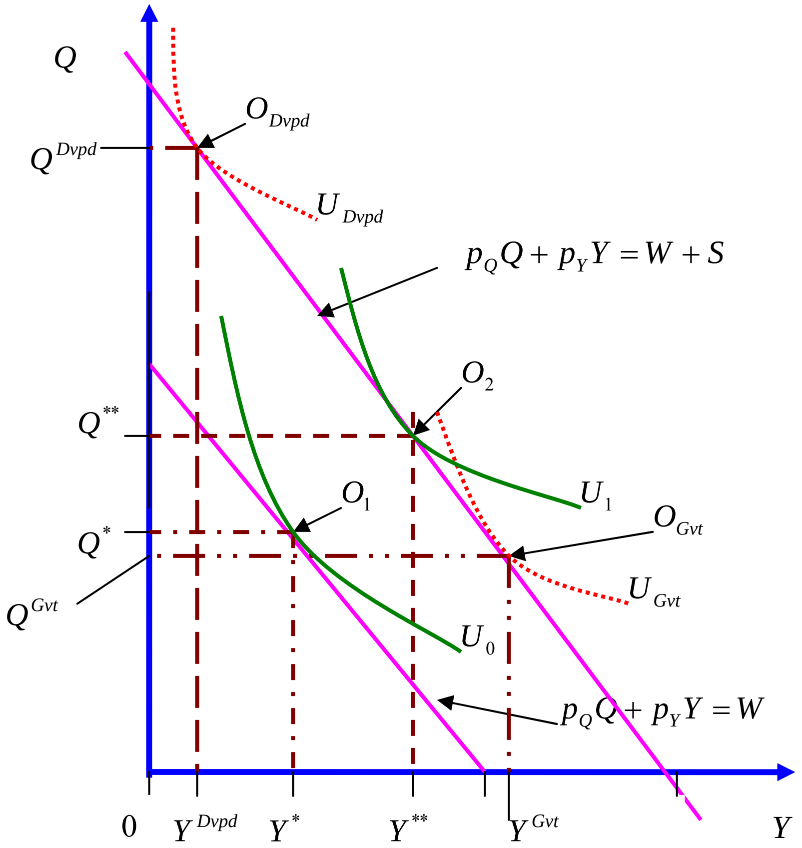
In the absence of information asymmetry and rigidities in enforcement, high demands for environmental quality by SDA providers may sometimes render the assistance inefficient in developing countries. On the other hand, in the presence of moral hazard, governments of poor countries may put too much weight on output growth rendering the assistance inefficient as well.

A high demand for environmental quality outcome by developed countries from SDA such as Q^{Dvpd} in figure 3.1.1 (c) implies a movement by the developing country from the optimal SDA allocation, O_2, to a non-optimal point, O^{Dvpd}, with lower than optimal output Y^{Dvpd} but higher than optimal environmental quality, Q^{Dvpd}. This is however possible under perfect monitoring and perfect enforcement mechanisms, the necessary conditions that enable providers of financial SDA force developing countries to produce at their optimal consumption levels, which sometimes have higher environmental quality levels than the developing countries' own optimal as illustrated in figure 3.1.1 (c).

Despite the creation of institutions to monitor the funds, perfect information is never achievable. The presence of moral hazard sometimes makes pre-cure financial assistance in environmental management ineffective in developing countries. Since developing countries prioritize output growth at the expense of environmental quality, in the absence of an effective monitoring system by the assistance providers, governments of these countries may give too much weight on output growth thereby producing more than optimal output and less than optimal environmental quality. For example, figure 3.1.1 (c) indicates that if the government's utility, U_{Gvt}, is more biased towards output growth than the country's utility, U_1, then the country normally consumes at a lower and inefficient indifference curve. Consider also the situation in figure 3.1.1 (c) where the government chooses allocation O^{Gvt} with larger than optimal output, Y^{Gvt}, and less than optimal environmental quality, Q^{Gvt}, to satisfy its own utility, U_{Gvt}, the country will consume at a lower and inefficient indifference curve, U_{Ineff}.

Under extreme cases in which governments of developing countries derive insignificant utility from environmental air quality improvements, inefficient allocation might be further biased towards output growth to the extent that environmental quality might deteriorate to levels lower than the initial levels before the financial SDA. On the other hand, if developed countries have utility extremely biased towards high outcomes of environmental quality from financial SDA, then with perfect monitoring and no enforcement problems, output in developing countries might deteriorate to levels lower than those before financial SDA. Figure 3.1.1 (d) illustrates the two extreme cases.

Figure 3.1.1 (d)
An extreme case of non-optimal allocation



Extremely inefficient allocations, O_{Dvpd} and O_{Gvt}. The two allocations are worse than the optimal with financial SDA.

Figure 3.1.1 (d) indicates that an allocation O_{Dvpd} is associated with very high environmental quality, Q^{Dvpd}, but very small output, Y^{Dvpd}, smaller than the initial output, Y^*, before financial SDA. This is not conducive for developing countries whose output levels are still not enough to feed their starving populations. The other extreme allocation is at point O_{Gvt}, where the government of a developing country gives extreme weight on output production. At this allocation point, the output size, Y^{Gvt}, is very large but the environmental quality has decreased from the initial level without financial SDA, Q^*, to a lower level, Q^{Gvt}. However, extreme allocations as illustrated in figure 3.1.1 (d) are more unlikely.

It is therefore indicated in this section that the inefficiency of financial SDA may be a result of either that the assistance providers, with perfect information and no enforcement problems, demand greater than optimal environmental quality outcomes from poor countries or that under moral hazard, governments of developing countries put greater than optimal weight on output production. Following this theoretical framework, the study assumes the presence of moral hazard and rigidities in enforcement by financial SDA providers. So the study assumes that the significant weight of inefficiency comes from the distortions caused by government allocations in developing countries.

3.1.2 Financial SDA in a Static Model with Clean-up Expenditure

The static model explains how economic activities are linked to the quality of the environment. It explains how economies divide income from production, Y, into consumption, C, and clean-up expenditures, X, and how waste from production and consumption affects the environment. This study attempts to fit in financial SDA in this theoretical model framework. Figure 3.1.2 summarizes the static model with clean-up expenditures.

In this study, it is assumed that financial SDA is provided as a lump sum thereby adding to the total resources of a country to give its total income or output, $Y_{SDA} = Y + SDA$. Let the consumption after financial SDA be C_{SDA} and the country's clean-up expenditure after financial SDA be X_{SDA}, then by introducing financial SDA as lump sum, the developing country's national income expands from $Y = C + X$ to

(3.1.2.1) $$Y_{SDA} = C_{SDA} + X_{SDA}$$

In figure 3.1.2, environmental quality is a function of national income, Y, and clean-up expenditures, X, that is, $Q = Q(Y, X)$. But with financial SDA the environmental quality will be a function of financial SDA-related national income and financial SDA-related clean-up expenditures, that is,

(3.1.2.2) $Q = Q(Y_{SDA}, X_{SDA})$

A total differentiation of (3.1.2.1) gives

(3.1.2.3) $dY_{SDA} = dC_{SDA} + dX_{SDA}$ and that of (3.1.2.2) gives

(3.1.2.4) $dQ = Q_{YSDA}\, dY_{SDA} + Q_{XSDA}\, dX_{SDA}$

$= Q_{YSDA}(dC_{SDA} + dX_{SDA}) + Q_{XSDA}\, dX_{SDA}$ (from (3.1.2.3))

$= Q_{YSDA}\, dC_{SDA} + (Q_{YSDA} + Q_{XSDA})dX_{SDA}$, where Q_{YSDA} is the change in environmental quality resulting from a marginal change in national income with financial SDA and Q_{XSDA} is the change in environmental quality resulting from a marginal change in financial SDA-related clean-up expenditures. Alternatively, Q_{YSDA} can be taken as the impact weight of a change in financial SDA-related consumption on environmental quality and $(Q_{YSDA} + Q_{XSDA})$ is the impact weight of a change in financial SDA-related clean-up expenditures on environmental quality. It is expected that an increase in national output/income reduces environmental quality, that is, $Q_{YSDA} < 0$ and an increase in clean-up expenditures increases environmental quality, that is, $Q_{XSDA} > 0$. From (3.1.2.4), the term $Q_{YSDA}\, dC_{SDA}$ is negative, that is, $Q_{YSDA}\, dC_{SDA} < 0$, since $Q_{YSDA} < 0$ and $dC_{SDA} > 0$ and $dX_{SDA} > 0$. Therefore, a necessary but not sufficient condition for dQ to be positive is that $|Q_{YSDA}| < Q_{XSDA}$, that is, the environment must be more responsive to SDA-related clean-up processes than to SDA-related production waste accumulation, and the sufficient condition is $(Q_{YSDA} + Q_{XSDA})dX_{SDA} > -Q_{YSDA}\, dC_{SDA}$. The inequality illustrates that if financial SDA increases clean-up expenditures by more than the increase in consumption then environmental quality will improve, that is, in addition to the necessary condition, the conditions $dX_{SDA} > dC_{SDA}$ and $Q_{YSDA} + Q_{XSDA} > |Q_{YSDA}|$ improve Q. In other words, financial SDA improves environmental quality if clean-up expenditure is more responsive to national income changes than consumption.

If it is assumed that financial SDA enters the production process as financial capital input (the accounting capital definition), then the production function in figure 3.1.2 is expressed as:

(3.1.2.5) $Y = Y(K, L, T, SDA)$,

where K, L, T *and* SDA are physical capital, labour, technology and financial capital, respectively. A total differential of the production function gives

(3.1.2.6) $dY = Y_K dK + Y_L dL + Y_T dT + Y_{SDA}\, dSDA$, where $Y_z = \frac{\partial Y}{\partial Z}$ for any Z.

The environmental quality is a function of output, Y , and clean-up expenditures, X , that is,

(3.1.2.7) $Q = Q(Y, X)$

Differentiating this function gives

(3.1.2.8) $dQ = Q_Y dY + Q_X dX$

$= Q_Y (Y_K dK + Y_L dL + Y_T dT + Y_{SDA}\, dSDA) + Q_X dX$ (from (3.1.2.6))

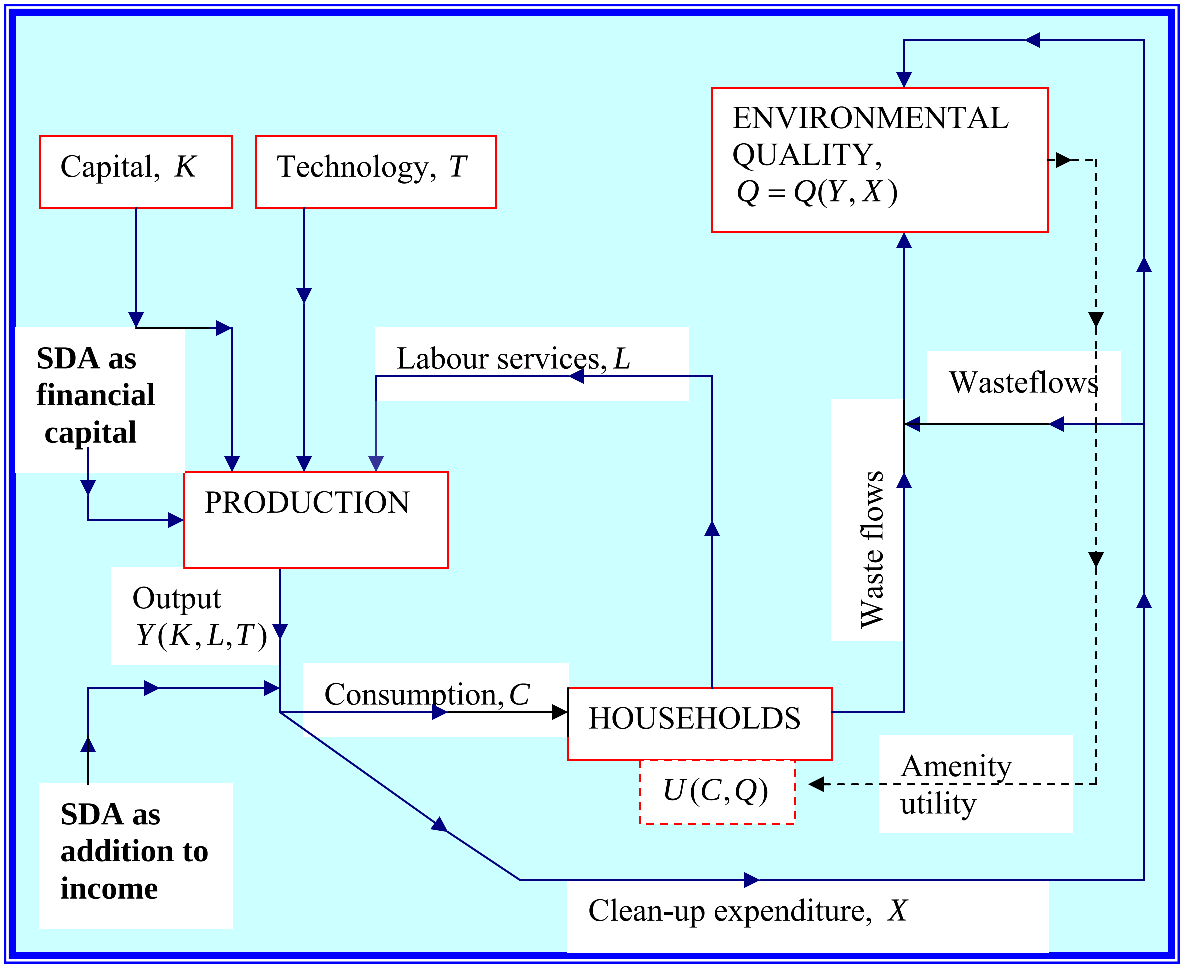
$= Q_Y Y_K dK + Q_Y\, Y_L dL + Q_Y\, Y_T dT + Q_Y\, Y_{SDA}\, dSDA + Q_X dX$

Holding all other factors of production constant, we obtain the partial derivative of the environmental quality with respect to financial SDA as

(3.1.2.9) $\frac{dQ}{dSDA} = Q_Y Y_{SDA}$ (< 0), where $Q_Y = \frac{\partial Q}{\partial Y}$ (<0) and $Y_{SDA} = \frac{\partial Y}{\partial SDA}$ (> 0)

So in cases where developing countries use financial SDA as financial capital input in production, the environmental quality might deteriorate due to increased output growth. In this case financial SDA reduces environmental quality.

Figure 3.1.2
The Impact of Economic Processes on Environmental Quality



Source: Environmental economics literature

3.2 METHODOLOGY

The study makes use of panel data econometrics to examine the efficacy of financial development assistance in managing greenhouse gases emissions in SSA countries. The choice of this method is based on the weight of its advantages relative to pure time series and pure cross-sectional data procedures. Greenhouse gases emissions and Sustainable Development Assistance (SDA) vary across the SSA countries and also over time. Countries in the region exhibit individual-specific variables such as policies, managerial capabilities, corruption levels, among others and period-specific variables such as economic depressions and booms may not be ruled out. Such individual-specific and period-specific variables require the use of panel data. Pure cross-sectional data contain no information on period-specific variables or on the effect of period-specific variables and on the other hand, pure time series data contain no information on individual differences or on effects of individual-specific variables. Panel data make it possible to circumvent this problem while at the same time control for individual-specific and time-specific heterogeneity. A detailed discussion on the advantages of panel data can be found in Baltagi (1995), Hsiao (1986), Bailer (1989), Kasprzyk et al (1989), and Biørn (2007), among others.

Following the suggested theoretical relationship between SDA and greenhouse gases emissions, SDA and economic growth and the previous studies on the determinants of air quality by Shafik, Seldom and Song, and Grossman and Krueger as discussed in chapters two and three, this study considers three functional forms in SSA countries; the linear, the quadratic and the cubic models.

3.2.1 The Empirical Model

The empirical model is derived from the theoretical framework in section 3.1 and it is defined as:

(3.2.1.1)

$$GHGEMPGDP_{it} = f\ (SDAPGDP_{it}, ENUSEPGDP_{it}, MANSHARE_{it}, GDPPCAP_{it}, \varepsilon_{it}),$$

where $GHGEMPGDP_{it}$ is the amount of greenhouse gases emissions embodied in a unit of GDP for country i in period t, $SDAPGDP_{it}$ is the amount of sustainable development assistance embodied in a unit of GDP for country i in period t, $ENUSEPGDP_{it}$ is a measure of the intensity of energy use per unit of output for country i in period t, $MANSHARE_{it}$ is the share of manufacturing for country i in period t and $GDPPCAP_{it}$ is per capita income for country i in period t. The variables are in terms of per unit of output for easier comparisons across countries and over time. The GDP for every country in the study is expressed in US$ at 2000 constant prices. The variables abbreviations are defined in table 3.2.1 below.

Table 3.2.1

Definition of Variable Abbreviations

$GHGEMPGDP_{it}$	Greenhouse Gases Emissions per unit of output
$SDAPGDP_{it}$	Sustainable Development Assistance per unit of output
$ENUSEPGDP_{it}$	Energy Use as output share
$MANSHARE_{it}$	Manufacturing Share
$GDPPCAP_{it}$	Gross Domestic Product (national output) per capita

It is also assumed that there is a time lag between the time Sustainable Development Assistance (SDA) is received and the desired outcomes. This study considers the effect of SDA received in the previous two years on the current green house gases emissions. In addition, the lagged variables of income are also considered since previous income levels might have an impact on the nation's budget for current clean-up expenditures, its current fleet of automobiles (carbon emitters), and its current state of technology . The model (3.2.1.1) will therefore include the two lagged variables of $SDAPGDP_{it}$ and those of $GDPPCAP_{it}$. Hence it can be expressed as:

(3.2.1.2) $GHGEMPGDP_{it} = \eta_i^* + \underset{(1\times K)(K\times 1)}{Z_{it}\,\beta} + \varepsilon_{it}$, where Z_{it} is a $1\times K$ row vector of all the explanatory and pre-determined variables, that is, Z_{it} *contains* $SDAPGDP_{it}, ENUSEPGDP_{it}, MANSHARE_{it}, GDPPCAP_{it}, SDAPGDP_{it-1}$, $SDAPGDP_{it-2}$, $GDPPCAP_{it-1}$, *and* $GDPPCAP_{it-2}$. All the variables in Z_{it} are assumed to be exogenous in this model. ε_{it} is the random error term that satisfies, $\varepsilon_{it} \sim IID(0,\sigma^2)$. Both Z_{it} and ε_{it} are assumed to be independently distributed for all i and t. $\beta = [\beta_1 \quad \beta_2 \quad . \quad . \quad . \quad . \quad \beta_K]^{/}$ is the $K\times 1$ column vector of slope coefficients and η_i^* is a constant specific to individual i.

Despite the fact that some of the countries in SSA region like Mozambique and Angola have been in civil wars in the 1980s, they continued to receive sustainable development assistance. The WBDIS of 2007 indicates that every country in the SSA region received

SDA at least once between 1970 and 2000 irrespective of its policy rating, corruption level and other issues such as political stability. In addition to this, the World Bank (2001) reports that lack of determinants for the size of sustainable development assistance to be provided to a given developing country by developed countries might cause the assistance to be ineffective. The absence of conditionality placed on SDA by donors provides an insight of ruling out the presence of a reverse causality or simultaneity bias between greenhouse gases emissions and financial SDA in SSA region from 1970 to 2000.

The study also considers a situation in which the previous period greenhouse gases emissions influence the current period emissions. It is assumed that the accumulation of previous emissions in the current period might increase the current emissions due to the deprivation of the current clean-up expenditure of its income share, which will be allotted to previous emissions clean-up. In this case a dynamic panel data model is considered. The model, which includes the lagged variable of the dependent variable, $GHGEMPGDP_{it-1}$, is as follows:

(3.2.1.3) $GHGEMPGDP_{it} = \eta_i^* + GHGEMPGDP_{it-1}\lambda + Z_{it}\beta + \varepsilon_{it}$, where the variables are as defined in the model (3.2.1.2) except for $GHGEMPGDP_{it-1}$ which is non exogenous. λ is the autoregressive coefficient assumed to be less than one in absolute value, a standard assumption for stationary AR(1)[4] models in pure time series. Applying Ordinary Least Squares (OLS) on model (3.2.1.3) gives biased and inconsistent estimators since ε_{it} is correlated with $GHGEMPGDP_{it-1}$. The within-individual estimator of the autoregressive coefficient in this model is inconsistent, with negative bias, if $N \to \infty$ and T is finite. It is only consistent if $T \to \infty$ for any N. The estimators of the N intercepts η_i^* are inconsistent if $N \to \infty$ and T is finite. They are consistent if $T \to \infty$ for any N.

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[4] AR(1) means autoregressive model of order one, that is, only one lag is considered for the dependent variable.

To eliminate the fixed individual-specific effects in model (3.2.1.3) and to be assured of consistent estimators, the study estimates the model in differenced form by instrumental variables[5]. The lagged levels, $GHGEMPGDP_{it-2}$ and $GHGEMPGDP_{it-3}$, the Z_{it} variables and the lagged differences $\Delta GHGEMPGDP_{it-2}$ and $\Delta GHGEMPGDP_{it-3}$ are potential instruments for $\Delta GHGEMPGDP_{it-1}$ in the following model:

(3.2.1.4) $$\Delta GHGEMPGDP_{it} = \Delta GHGEMPGDP_{it-1}\lambda + \Delta\varepsilon_{it}$$

These potential instruments are correlated with $\Delta GHGEMPGDP_{it-1}$ and uncorrelated with $\Delta\varepsilon_{it}$. This study uses all of these stated potential instruments except $\Delta GHGEMPGDP_{it-2}$ which is dropped because of perfect multicollenearity. A detailed discussion on dynamic panel data models can be found in Biørn (2007), Baltagi (2005), Hsiao (2003), and Greene (2000), among others.

It is from these panel data functions where two possible models of panel data can emerge. These are the fixed effects (FE) model and the random effects (RE) model. The models can either have two-way or one-way heterogeneity but this study applies two-way heterogeneity models since green house gases emissions vary across SSA countries and also over time. There is a possibility of the existence of both period and individual heterogeneity.

The Random Effects or the Fixed Effects Model?

One of the major problems for an applied researcher in decision making pertains to the choice between treating the effect as fixed or as random. Balestra (1992), Baltagi (1995) and Maddala (1987), among others propose several guidelines regarding this problem. Balestra (1992, p.27) says, “if individual effects are believed to be related to a large number of non-observable random causes, then the random interpretation is clearly indicated.” In support of this view, Maddala (1987, p.304) argues, “the η_i^* measure individual-specific effects that we are ignorant about just as the same way that ε_{it}

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[5] Instrumental variables are variables which are correlated with the variables which they serve as instruments and are exogenous explanatory variables in the model in which they serve as instruments. A detailed discussion on instrumental variables is found in econometric literature (Gujarati, 2003).

measure effects for the i^{th} cross-section unit in the t^{th} period that we are ignorant about. Thus if ε_{it} is treated as a random variable, then there is no reason that η_i^* should be not." The random effects model is said to be more appropriate when N individuals are randomly drawn from a large population. On the other hand the fixed effects model is an appropriate specification if the sample is closed or exhaustive.

Owusu-Gyapong (1986) argues that the within-group estimator fails to estimate time-invariant effects and it therefore wastes useful information contained in the relations among individual means. So the random effects model is more appropriate in cases where the researcher has some time-invariant observations. The fixed effects model also known as the Least Squares Dummy Variables (LSDV) model suffers from an enormous loss of degrees of freedom for panel data sets where N is very large relative to the size of T. It therefore gives inconsistent parameters. By comparing within estimator with the Swamy-Arora Feasible Generalized Least Squares (FGLS) estimator, Taylor (1980) proposes that the FGLS is more efficient than the LSDV estimator for all but fewest degrees of freedom and the variance of the FGLS estimator is never more than 17% above the Cramer-Roa lower bound. For the choice of whether to use fixed effects or random effects, most studies have however ignored the use of apriori reasons stipulated in this section. Instead researchers use the Hausman test to choose between the fixed effects and the random effects procedures. This study avoids apriori reasoning by making use of the Hausman test in the choice between the fixed effects and random effects models.

The Hausman Test for Random Effects

A critical assumption in the random effects model is that E(η_{it}, Z_{it}) = 0. This is important given that the disturbances contain individual invariant effects (η_{it}) which are unobserved and may be correlated with Z_{it}. If E(η_{it}, Z_{it}) ≠ 0, then the Generalized Least Squares (GLS) estimator, $\overset{\wedge}{\beta}_{GLS}$, becomes biased and inconsistent for β. On the other hand, the within transformation will wipe out the η_i and leave the within estimator, $\overset{\wedge}{\beta}_{Within}$, unbiased and consistent for β. Hausman (1978) developed a test based on comparing $\overset{\wedge}{\beta}_{GLS}$ and $\overset{\wedge}{\beta}_{Within}$, both of which are consistent under the null hypothesis, H_0: $Cov(\eta_{it}, Z_{it}) = 0$, but with different probability limits if H_0 is not true. $\overset{\wedge}{\beta}_{Within}$ is consistent whether H_0 is true or not, while $\overset{\wedge}{\beta}_{GLS}$ is the best linear unbiased estimator (BLUE), consistent and asymptotically efficient under H_0, but is inconsistent when H_0 is not true. The Hausman test can be summarized as:

H_0: $Cov(\eta_{it}, Z_{it}) = 0$

H_1: $Cov(\eta_{it}, Z_{it}) \neq 0$

The test statistic is given by:

$H = \left(\overset{\wedge}{\beta}_{Within} - \overset{\wedge}{\beta}_{GLS}\right)^{/}\left[Var\left(\overset{\wedge}{\beta}_{Within}\right) - Var\left(\overset{\wedge}{\beta}_{GLS}\right)\right]^{-1}\left(\overset{\wedge}{\beta}_{Within} - \overset{\wedge}{\beta}_{GLS}\right) \sim \chi^2_K$, where K is the dimension of slope vector, β. If H is significant, that is, if H_0 is rejected, the fixed effects model will be more appropriate. Otherwise, the random effects model will be more appropriate. This study finds no evidence to reject H_0 since $H = 7.89$ with a p-value[6] of 24.63%. Hence the results confirm that the random effects model is more appropriate in modeling the impact of financial SDA on green-house gases emissions in SSA countries (see Appendix B (I)). Detailed discussions on the Hausman test are found in Hausman (1978), Biørn (2007), Baltagi (2005), Hsiao (2003), and Greene (2000), among others.

The Random Effects Model

In models with fixed effects, no assumptions are made about individual-specific intercepts, η_1^*, η_2^*, ..., η_N^*. In the case that the individual-specific effects are randomly distributed across units, a random effects model will be more appropriate. The regression equation is

(3.2.1.5) $GHGEMPGDP_{it} = \eta_i^* + Z_{it}\beta + \varepsilon_{it}$

This equation is defined over $i = 1$,........, N and $t = 1$, ..., T. The individual-specific intercepts, η_i^* satisfy E(η_i^*) = k, var(η_i^*) = σ_η^2, cov(η_i^*, η_j^*) = 0 for $j \neq i$ and

---

[6] P-value is the minimum boundary probability at which the null hypothesis is rejected

$i, j = 1,..,T$, where k and σ_η^2 are unknown constants. It is also assumed that η_i^*, ε_{it} and all the explanatory variables are independently distributed. By letting $\eta_i = \eta_i^*$ - E(η_i^*) = η_i^* - k , we can express the regression equation with stochastic individual-specific effects as:

(3.2.1.6)
$$\begin{aligned} GHGEMPGDP_{it} &= \eta_i^* + Z_{it}\beta + \varepsilon_{it} \\ &= k + Z_{it}\beta + \varepsilon_{it} + \eta_i \\ &= k + Z_{it}\beta + u_{it} \end{aligned}$$

where $u_{it} = \varepsilon_{it} + \eta_i$

$\varepsilon_{it} \sim IID(0_{T,1}, \sigma^2 I_T)$, i = 1,........, N t = 1, ..., T

$\eta_i \sim IID(0, \sigma_\eta^2)$

u_{it} is a composite or gross disturbance composed of two different error components, hence regression models of this type are also referred to as error components models. The GLS gives MVLUE estimators if σ_η^2 and σ^2 are known. In the event that the two variances are not known, the FGLS gives MVLUE estimators. The two estimators have an advantage of being weighted averages of the within-group and between-group estimators and therefore enable the researcher to extract information from the two variations as discussed in Green (2003) and Owusu-Gyapong (1986).

3.2.2 Variable Definition and Justification

The dependent variable in this study, greenhouse gases emissions per unit of output (*GHGEMPGDP*), gives the content of greenhouse gases embodied in a unit of output. This provides a proxy measure for environmental air quality. $GHGEMPGDP_{it}$ is therefore the amount of greenhouse gases emissions per unit of output in country i in period t and is measured in metric tons of carbon. The components of greenhouse gases include carbon dioxide, nitrous oxide, methane and other gases. By using greenhouse gases emissions as the dependent variable makes it difficult to compare the state of the environmental quality across countries or over time. It is against this background that this study suggests to use *GHGEMPGDP* as the dependent variable rather than greenhouse gases emissions. $GHGEMPGDP$ makes it possible to compare whether the 1990 output was cleaner (embodied less emissions of greenhouse gases) than the 2000 output in country i or whether country i's output is cleaner (has less content of greenhouse gases emissions) than country j's. It is also easier to examine the impact of financial sustainable development assistance and energy use on the proportion of greenhouse gases embodied in output.

The main objective of this study is centered on the impact of financial SDA on environmental air quality in SSA countries. There are four explanatory variables in this study, namely, Sustainable Development Assistance per unit of output ($SDAPGDP$), energy use per unit of output ($ENUSEPGDP$), manufacturing share or the percentage value added by manufacturing ($MANSHARE$), the Gross Domestic Product per capita ($GDPPCAP$) and four pre-determined variables, the lagged variables of $SDAPGDP$, $SDAPGDP_{it-1}$ and $SDAPGDP_{it-2}$ and the lagged variables of $GDPPCAP$, $GDPPCAP_{it-1}$ and $GDPPCAP_{it-2}$.

The lagged variables of SDA are included as possible determinants of the variations in environmental quality. When developing countries receive the assistance, they do not instantaneously use the funds but they require planning time for investment decisions. Even if the SDA is instantaneously invested, a time lag between the investment period and output production always exists. The existence of such time lags implies that the decisions that were made during the previous periods might have an impact on the current outcomes. SDA received in the previous periods might have a strong influence on current emissions. However, it is not easy to pick the actual memory length for a variable. The SDA might have a 10-year memory which calls for several lagged variables but this study assumes that SDA has a 2-year memory history. In the case of previous period's incomes, the study proposes to include income lags as possible determinants of air quality since high incomes in the previous period might add up to current clean-up budget or there might be a period lag between output production and conversion into green house gases. An example might be explained by the importation of automobiles in poor countries, characterized by a time lag between the realization of increased income and the increased acquisition of automobiles, which normally takes long because of importation and clearance procedures.

$SDAPGDP_{it}$ is the amount of SDA embodied in every unit of output produced in country i in period t and is measured in constant 2000 US$ for all countries in the study. The use of per unit output SDA deflates the inflated values of SDA thereby making it possible to compare variations of SDA across SSA countries. $ENUSEPGDP_{it}$ measures how much energy is used per every unit of output in country i in period t. It is measured in terms of kilograms of oil equivalent. The other variables, $GDPPCAP$ and $MANSHARE$ are per capita income and manufacturing share respectively. Manufacturing processes such as cement production, coal production, and oil refinery are some of the largest emitters of greenhouse gases. Manufacturing in turn plays a major role in the size of a country's GDP, increased manufacturing output increases the overall output of a country. It is against this background that the two variables are both considered to be important determinants of variations in environmental air quality. $GDPPCAP$ is measured at 2000 constant prices in US$ for every country in the study for comparability reasons.

In the dynamic model (3.2.1.3), $GHGEMPGDP$ is assumed to have memory of its own history, that is, it memorizes its previous period values. $GHGEMPGDP_{it-1}$ influences the current size of emissions because a proportion of the current clean-up expenditure has to be used to clean-up the previous period emissions.

3.2.3 Sources of Data

Data on all variables were collected from secondary sources that include SSA countries' national accounts data, the WBDIS (2007) (www.worldbank.org), the University of Oslo's electronic humanities library (www.ub.uio.no/uhs), Source OECD Statistics (new.sourceoecd.org), and Eurostat (epp.eurostat.cec.eu). The sources are found to be reliable since the same data collected from these sources show no deviations.

CHAPTER 4

EMPIRICAL RESULTS AND INTERPRETATION

4.1 STATISTICAL SUMMARY

On average a unit of output produced in the period between 1970 and 2000 in the 28 SSA countries embodied about 0.001082 metric tons of greenhouse gases equivalent to 0.001082×10^9 calories of energy, which is less than that of China alone in 1995. The 2007 WBDIS data show that in 1995 China's unit of output embodied over 0.00161 metric tons equivalent to 0.00161×10^9 calories of energy. The average per capita income value of US$678.1853 and the manufacturing share of 10% for SSA countries in the period 1970 to 2000 were comparably very low. Over the same period, the US's average per capita income and manufacturing share exceeded US$20000 and 20% respectively. Energy use was also comparably low in SSA countries with an average of 1.334160×10^9 calories of energy, much below the 1990 European Union average of more than 5×10^9 calories of energy. However, SSA countries received significant sustainable development assistance during the period, averaging about US$0.098 in a US$1 unit of output. Table 4.1 (a) illustrates the mean, the standard deviation (Std. Dev), the minimum (min) and the maximum (max) values of each variable in this study. These values are global[7] because they are a result of global summations of the variables in question. The standard deviation is also global as it is measured as the square root of the squared deviations of the variables from their global means.

Variations in *GHGEMPGDP, SDAPGDP* and *GDPPCAP* are very huge in the SSA region but *ENUSEPGDP* and *MANSHARE* exhibit minor variations across the 28 countries over the study period.

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[7] Global mean = $\bar{x} = \frac{1}{NT}\sum_{i=1}^{N}\sum_{t=1}^{T} x_{it}$ and Global Std. Dev = $\sqrt{\frac{\sum_{i=1}^{N}\sum_{t=1}^{T}\left(x_{it} - \bar{x}\right)^2}{NT}}$. A detailed discussion on global mean and global standard deviation can be obtained in Hsiao (2003).

Table 4.1 (a)

Global summary statistics for N = 28 and T = 31

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
GHGEMPGDP	868	0.001082	0.001275	0.00000	0.019059
SDAPGDP	868	0.098250	0.112849	0.00000	1.272498
ENUSEPGDP	868	1.334160	0.789478	0.24195	5.048818
GDPPCAP	868	678.1853	971.1350	56.5200	7714.230
MANSHARE	868	0.104124	0.052852	0.03000	0.370000
$SDAPGDP_{t-1}$	867	0.098336	0.112886	0.00000	1.272498
$SDAPGDP_{t-2}$	866	0.098413	0.112928	0.00000	1.272498
$GDPPCAP_{t-1}$	867	678.2904	971.6906	56.5200	7714.230
$GDPPCAP_{t-2}$	866	678.3300	972.2514	56.5200	7714.230

However, no information for period or country comparisons can be derived from table 4.1 (a). Statistical summaries of country-specific means ($\bar{x}_{i.}$) and period-specific means ($\bar{x}_{.t}$) are important to analyze how the study variables have evolved over time and across SSA countries. Such useful statistical summaries are illustrated in tables 4.1 (b) and (c).

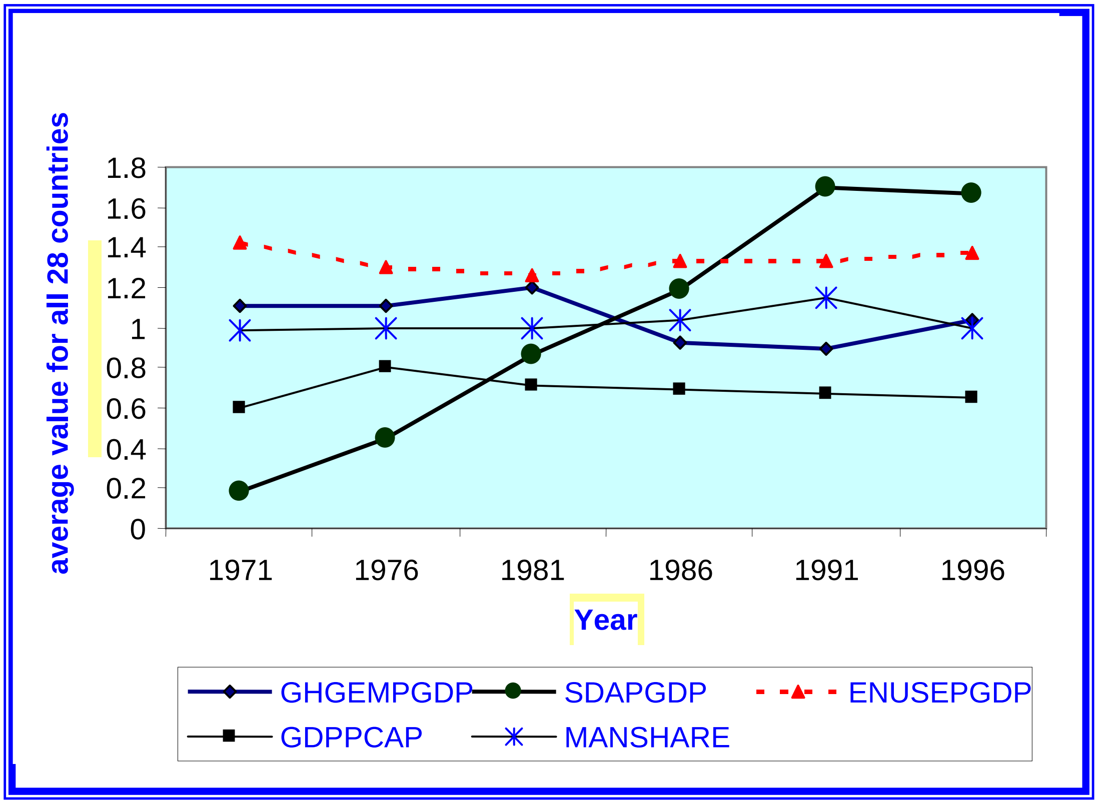
Table 4.1 (b) shows that the mean value of greenhouse gases emissions embodied in a unit of output for SSA countries fell by about 15% from 0.000988 metric tons in 1970 to about 0.000837 metric tons in 2000, despite the fact that the region's emissions were comparably low. During the same period, the mean value of financial SDA embodied in a unit of output increased from US$0.016 in 1970 to about US$0.085 in 2000. The average manufacturing share remained almost constant at 10% whilst the average per capita income rose from US$577.8 in 1970 to about US$688.2 in 2000. For more year-specific summaries, see an extension of table 4.1 (b) in appendix A. The selection of years is done through random sampling of the first year then followed by systematic sampling for the rest of the other years in the sample. Figure 4.1 (a) illustrates trends in mean values of GHGPGDP, SDAPGDP, ENUSEPGDP, GDPPCAP and MANSHARE for randomly selected years.

Table 4.1 (b)

Year-specific summary statistics for N = 31 (Examples: 1970 and 2000)

		Obs	*Mean*	*Std. Dev*	*Min*	*Max*
1970	***GHGEMPGDP***	28	0.000988	0.001057	0.000000	0.004431
	SDAPGDP	28	0.016472	0.014352	0.000000	0.066941
	ENUSEPGDP	28	1.481366	1.067114	0.517739	5.048818
	GDPPCAP	28	577.8057	719.2399	121.6000	3104.000
	MANSHARE	28	0.096786	0.047380	0.030000	0.230000
		Obs	*Mean*	*Std. Dev*	*Min*	*Max*
2000	***GHGEMPGDP***	28	0.000837	0.000884	0.000035	0.003329
	SDAPGDP	28	0.085145	0.074453	0.002365	0.255926
	ENUSEPGDP	28	1.317599	0.703436	0.263672	2.967655
	GDPPCAP	28	688.2039	1008.019	96.77000	3876.900
	MANSHARE	28	0.096428	0.048779	0.030000	0.210000

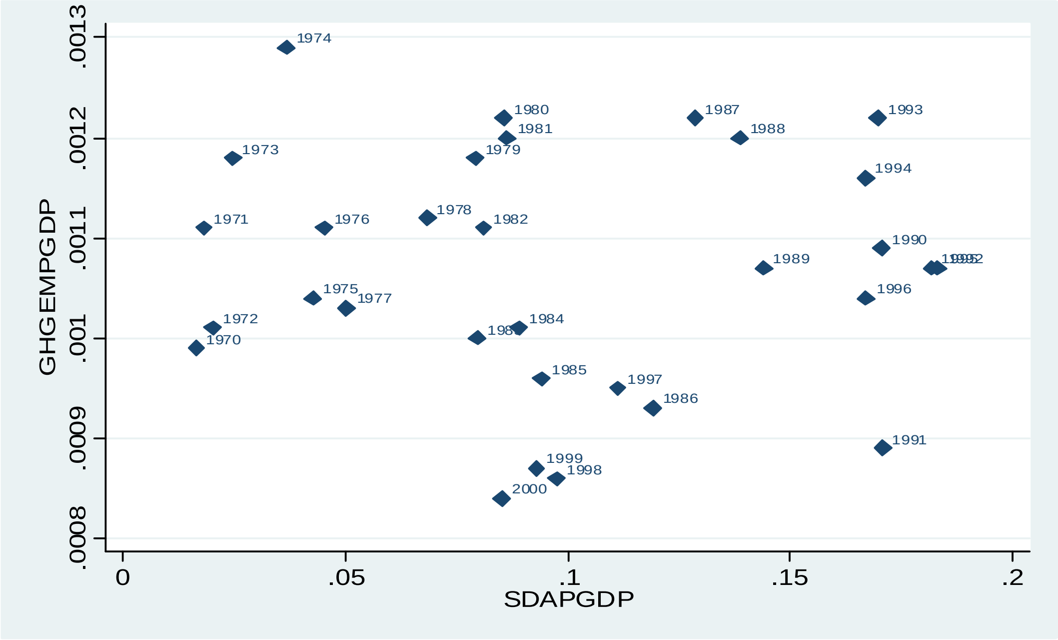
Figure 4.1 (a)
Year-specific average trends



In figure 4.1 (a), GHGPGDP is expressed in terms of per thousand metric tons of carbon, SDAPGDP in tenth US$, ENUSEPGDP in kilograms of oil equivalent, and GDPPCAP in thousand US$. The graph shows that GHGEMPGDP remained almost constant in SSA region from 1971 to 1996 despite the increasing trend of SDAPGDP in the region. The other variables, ENUSEPGDP, GDPPCAP and MANSHARE show minor variations over this period. The graph also indicates closer relationships between GHGPGDP and ENUSEPGDP, GDPPCAP and MANSHARE than between GHGPGDP and SDAPGDP.

Figure 4.1 (b)

Scatter plot for year averages of GHGEMPGDP against SDAPGDP



Like figure 4.1 (a), the scatter graph for year averages of GHGEMPGDP against year averages of SDAPGDP in figure 4.1 (b) indicates that there is no clear relationship between greenhouse gases emissions and sustainable development assistance over time. The scatter graph illustrates each point (x;y) = (Average SDAPGDP; Average GHGEMPGDP) for every year from 1970 to 2000. There is no clearly defined pattern for the distribution of years in the scatter, making it difficult to see the nature of the relationship between GHGEMPGDP and SDAPGDP over time in SSA countries.

Table 4.1 (c)

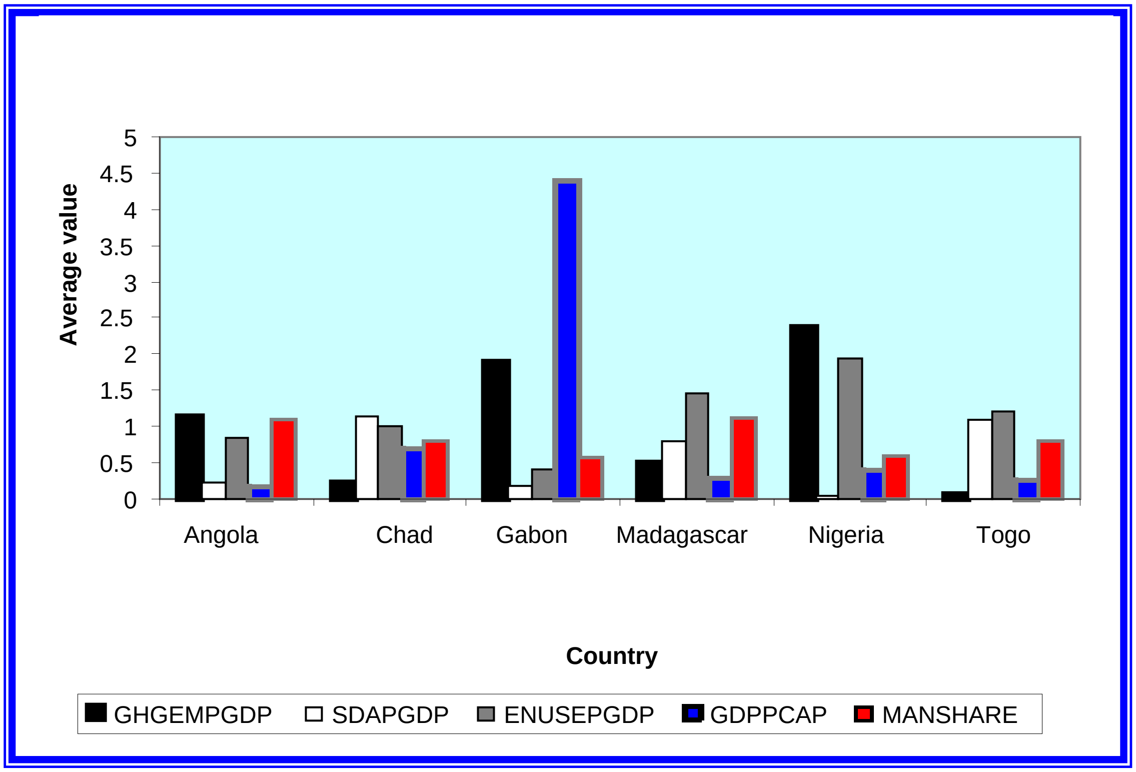
Country-specific summary statistics (Examples: Zimbabwe and South Africa)

		Obs	***Mean***	***Std. Dev***	***Min***	***Max***
Zimbabwe **(co = 28)**	***GHGEMPGDP***	31	0.003269	0.001067	0.001836	0.004884
	SDAPGDP	31	0.034486	0.029359	0.000015	0.122410
	ENUSEPGDP	31	1.444132	0.118513	1.207407	1.653136
	GDPPCAP	31	620.9355	39.11516	542.0000	690.0000
	MANSHARE	31	0.209677	0.029831	0.160000	0.300000
	$SDAPGDP_{t-1}$	30	0.041627	0.047779	0.000015	0.245017
	$SDAPGDP_{t-2}$	29	0.046969	0.055299	0.000015	0.245017
		Obs	***Mean***	***Std. Dev***	***Min***	***Max***
SA **(co=23)**	***GHGEMPGDP***	31	0.003462	0.000344	0.002889	0.003913
	SDAPGDP	31	0.000898	0.001158	0.000000	0.004455
	ENUSEPGDP	31	0.783520	0.100393	0.633892	0.898987
	GDPPCAP	31	3181.742	173.5828	2903.000	3561.000
	MANSHARE	31	0.217419	0.014135	0.190000	0.240000
	$SDAPGDP_{t-1}$	30	0.003872	0.017154	0.000000	0.095949
	$SDAPGDP_{t-2}$	29	0.007766	0.027730	0.000000	0.125166

Unlike year-specific summary, the country-specific summary table summarizes the variables for a given country like the examples presented in table 4.1 (c). The table shows summaries of Zimbabwe and South Africa; randomly picked. By comparing their average greenhouse gases emissions, it is shown in the table that over the period 1970 to 2000, South Africa’s average greenhouse gases emissions embodied in a unit of output exceeds that of Zimbabwe and on average Zimbabwe’s unit of output contains a larger proportion of SDA than that of South Africa. For more country-specific summaries, turn to extension of table 4.1 (c) in appendix A. The countries are selected through random sampling of the first country then followed by systematic sampling-picking every fifth country in alphabetical order.

In figure 4.1 (c), it is shown that among the randomly selected countries, those with larger SDAPGDP have the lowest GHGEMPGDP. Chad and Togo have the largest SDAPGDP and the lowest GHGEMPGDP whereas Gabon and Nigeria have the smallest SDAPGDP and the highest GHGEMPGDP. Like in figure 4.1 (a), GHGPGDP is expressed in terms of per thousand metric tons of carbon, SDAPGDP in tenth US$, ENUSEPGDP in kilograms of oil equivalent, and GDPPCAP in thousand US$.

Figure 4.1 (c)
Country-specific average trends for selected countries

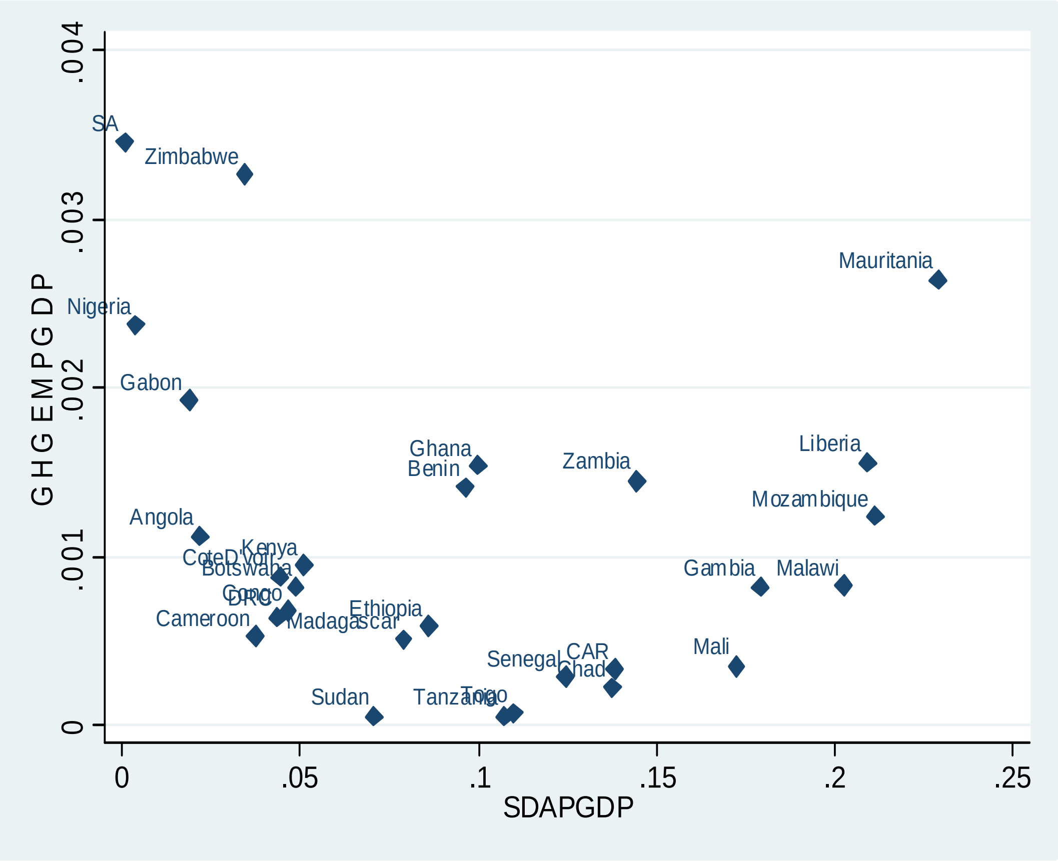


Source: Summary statistics.

The scatter graph for country averages of GHGEMPGDP against yearly averages of SDAPGDP in figure 4.1 (d) indicates that the relationship between greenhouse gases emissions and sustainable development assistance across SSA countries is non-linear. The graph illustrates each point (x;y) = (Average SDAPGDP; Average GHGEMPGDP) for every country from Angola to Zimbabwe. The 28 countries are distributed along a "U" curve in the scatter graph, with the curve's turning point likely to have SDAPGDP value of less than US$0.2 in a US$1 unit of output. In this case the turning point might be under-estimated or over-estimated because of the exclusion of the period effect (time dimension) and other determinants of greenhouse gases emissions considered in this study. Despite this drawback of the turning point, the distribution of countries in the scatter graph gives a hint that a quadratic functional form in terms of the SDAPGDP variable might provide a good fit for SSA data.

Figure 4.1 (d)

Scatter plot for country averages of GHGEMPGDP against SDAPGDP.



4.2 VARIABLES CORRELATIONS

Summary statistics such as the mean, standard deviation, maximum and minimum values discussed in section 4.1 fail to expose the nature of relationship between two variables. This problem can however be circumvented by finding the correlation coefficients which define whether two variables are positively, negatively or not correlated. In this section, correlations between the study variables are discussed. GHGEMPGDP is negatively correlated with SDAPGDP and the two lagged variables of SDAPGDP but positively correlated with ENUSEPGDP, MANSHARE GDPPCAP and the two lagged variables of GDPPCAP as illustrated in table 4.2 (a). The correlation coefficient between GHGEMPGDP and SDAPGDP has the expected negative sign. Table 4.2 (a) also show that the other correlation coefficients have the expected signs, that is, increases in output, energy use or manufacturing share are expected to increase greenhouse gases emissions. Despite the correctly expected signs, the coefficients indicate weak correlations between greenhouse gases emissions embodied in a unit of output and the explanatory variables.

The use of global correlation coefficient (σ_{xy})[8] makes it impossible to expose the nature of correlation between variables in one country or in a specific year. This problem can however be circumvented by running country-specific correlations and period-specific correlations. Table 4.2 (b) in appendix A illustrates a positive correlation coefficient between greenhouse gases emissions embodied in a unit of output and financial SDA embodied in a unit of output for Zimbabwe - randomly selected. The coefficient has a sign that differs from that of the global coefficient in table 4.2 (a). Table 4.2 (b) gives a hint on the fact that it is not in all countries that SDA reduces greenhouse gases emissions. The correlation coefficients of all the income variables are negative in Zimbabwe. On the other hand, year 2000(randomly selected)-specific correlation coefficients have the hypothesis-expected signs for SDAPGDP, GDPPCAP, MANSHARE and lagged variables of SDAPGDP and GDPPCAP but an unexpected negative sign for energy use as illustrated in table 4.2 (c) in appendix A. It is also indicated in table 4.2 (c) that, in year 2000, per capita incomes were positively correlated with greenhouse gases emissions in SSA.

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[8] The global correlation coefficient between x and y (σ_{xy}) = $\dfrac{\sum_{i=1}^{N}\sum_{t=1}^{T}\left(x_{it}-\bar{x}\right)\left(y_{it}-\bar{y}\right)}{\sqrt{\sum_{i=1}^{N}\sum_{t=1}^{T}\left(x_{it}-\bar{x}\right)^{2}}\sqrt{\sum_{i=1}^{N}\sum_{t=1}^{T}\left(y_{it}-\bar{y}\right)^{2}}}$

Table 4.2 (a)

The global correlation matrix

gdppcap$_{t-2}$									1.0000
Gdppcap$_{t-1}$								1.0000	0.9637
sdapgdp$_{t-2}$							1.0000	-0.2971	-0.3053
sdapgdp$_{t-1}$						1.0000	0.8515	-0.3055	-0.3037
manshare					1.0000	-0.0320	-0.0417	0.0604	0.0524
gdppcap				1.0000	0.0661	-0.2973	-0.2879	0.9637	0.9228
enusepgdp			1.0000	-0.4382	-0.0178	0.2818	0.2614	-0.4251	-0.4107
sdapgdp		1.0000	0.2999	-0.3057	-0.0174	0.8515	0.7578	-0.3039	-0.3003
ghgempgd	1.0000	-0.0851	0.0222	0.3153	0.2841	-0.0863	-0.0858	0.3033	0.2917
	ghgempgd	***sdapgdp***	***enusepgdp***	***gdppcap***	***manshare***	***sdapgdp$_{t-1}$***	***sdapgdp$_{t-2}$***	***gdppcap$_{t-1}$***	***gdppcap$_{t-2}$***

4.3 THE RANDOM EFFECTS RESULTS (LINEAR FORM)

Following the Hausman results presented in chapter three, the study applies the random effects model. The random effects coefficients illustrated in Table 4.3 indicate that financial SDA reduces greenhouse gases emissions across SSA region. However, the results provide no evidence of a significant impact of financial SDA and its lagged values on variations in greenhouse gases emissions in SSA. The result compares well with the theory of utility maximization with optimal allocation discussed in chapter 3, which assumes that poor countries' indifference curves are biased towards output growth, implying that a lump sum increase in the country's budget is likely to be followed by an over-weighted output growth and an under-weighted environmental quality improvement; an explicit support to the study hypothesis that SDA weakly reduces greenhouse gases emissions in poor countries. Other empirical studies discussed in chapter two also generally find no evidence that SDA significantly influence economic development in poor countries, though they are quiet on its impact on environmental quality. Based on the statistical evidence presented in table 4.3, the study's hypothesis of a weak positive relationship between $GHDGEMPGDP$ and $SDAPGDP$ cannot be rejected.

Energy use significantly and positively influences greenhouse gases emissions in SSA countries. The results from table 4.3 indicate that a one unit increase in energy use increases the share of greenhouse gases emissions embodied in a unit of output by about 0.04262%. This effect is very large given the almost constant average greenhouse gases emissions in SSA countries. The result is expected especially in poor countries like SSA countries in which technological growth is very slow leading to low rates of energy source substitution. But in countries where technology replaces highly pollutant energy sources by less pollutant ones, the coefficient of energy use might take either sign, positive or negative.

Table 4.3
The Random Effects Coefficients

GHGEMPGDP	***Coef.***	***Std. Err.***	***z***	$P>\lvert z \rvert$	***[95% Conf. Interval]***
SDAPGDP	-0.0000223	0.000545	-0.04	0.967	-0.001090 0.001046
ENUSEPGDP	0.0004262	0.000088	4.83	0.000^{***}	0.000253 0.000599
GDPPCAP	3.60e-07	1.50e-07	2.39	0.017^{**}	6.50e-08 6.54e-07
MANSHARE	0.002817	0.001095	2.57	0.010^{**}	0.000672 0.004963
$SDAPGDP_{t-1}$	-0.000168	0.000656	-0.26	0.798	-0.001454 0.001119
$SDAPGDP_{t-2}$	-0.000175	0.000534	-0.33	0.742	-0.001222 0.000871
$GDPPCAP_{t-1}$	-3.64e-08	1.73e-07	-0.21	0.833	-3.75e-07 3.02e-07
$GDPPCAP_{t-2}$	5.84e-08	1.21e-07	0.48	0.630	-1.79e-07 2.96e-07
_CONS	-3.70e-06	0.000236	-0.02	0.987	-0.000466 0.000458

The Gross Domestic Product per capita and the share of manufacturing are found to be significant determinants of greenhouse gases emissions in SSA countries. Increases in both per capita GDP and manufacturing share will increase greenhouse gases emissions in SSA countries. The coefficients of *GDPPCAP* and *MANSHARE* are both significant at 5% level. This result agrees with Shafik's 1994 findings. Shafik finds evidence of a significant positive effect of income on carbon emissions per capita. Grossman and Krueger (1995) use this same random effects estimation procedure and find evidence that the environmental quality deteriorates steadily with economic growth in countries with real per capita incomes below US$10 000. In SSA region, no country exceeds per capita real income of US$10 000, therefore this study's findings do not deviate from Grossman and Krueger's in terms of the current income variable. However, in terms of the lagged income variables, this study's findings deviate from Grossman and Krueger's who find evidence of a significant impact of these lagged variables on environmental quality.

4.4 THE DYNAMIC PANEL DATA MODEL

The dynamic random effects model indicates the existence of a positive relationship between changes in historic emissions and current emissions. However, the study finds no evidence to reject the hypothesis that the coefficient of $\Delta GHGEMPGDP_{t-1}$ in model (3.2.1.4) is zero. So we find evidence that historical growth rates of $GHGEMPGDP$ have insignificant impact on current growth of greenhouse gases emissions in SSA region. Appendix B (II) presents the dynamic Random Effects model.

4.5 THE QUADRATIC AND CUBIC FUNCTIONAL FORMS

The results in Appendix B (III) provide evidence that the quadratic functional form in SDA variable can fit the SSA data well whereas the cubic functional form provides the worst fit of the data. In the cubic model, all variables except energy use and manufacturing share are insignificant. The poor fit of both the quadratic and cubic models in terms of the income variables might be a result of the low levels of per capita income in SSA countries. Shafik, Grossman and Krueger find evidence that the quadratic and cubic functional forms in income variable provide the best fits for countries with income levels in excess of US$8 000 and US$16 000 respectively. So given the maximum per capita income of less than US$8000 in SSA countries, quadratic and cubic income terms are expected to be insignificant, as evidenced by the results in appendix B (III). Despite the negative sign of the squared income coefficient which implies an inverted "U" shaped curve for the relationship between greenhouse gases emissions and per capita income, the results provide no evidence to support the quadratic functional form in income variable.

In terms of the sustainable development assistance, the quadratic functional form seems to provide the best fit. The variables which are significant in the linear random effects model presented in section 4.3 are still significant at the 5% level in the quadratic form. In addition, the coefficient of the squared term of sustainable development assistance, $SDAPGDP_{it}^{2}$, is also significant at the 5% level and most importantly, the chi-square test for joint significance of the coefficients of the quadratic model provide evidence that the coefficients are simultaneously different from zero. The test for joint significance is presented together with the quadratic model in appendix B (III). The chi-square test statistic is 43.24 and significant at the 1% level, implying that the null hypothesis that the coefficients of the quadratic model are jointly equal to zero is rejected.

The coefficient of the SDA squared term (quadratic term) is 0.0019917 (> 0), implying that the relationship between SDA and environmental air quality can be illustrated through a “U” shaped curve in SSA countries. The quadratic function in terms of SDA can be presented as:

$GHGEMPGDP_{it} = 0.0000225 - 0.0013473 SDAPGDP_{it} + 0.0019917 SDAPGDP_{it}^2 + G_{it}\theta$,

where G_{it} is a vector of all the other variables in the quadratic model in appendix B (III) and θ is a vector of the associated coefficients. By partial differentiation of this function with respect to $SDAPGDP_{it}$ and equating the derivative to zero, we get the turning point[9] as 0.338. This value means that in SSA region greenhouse gases emissions fall with increases in SDA embodied in a unit of output when SDAPGDP is below US$0.338 per US$1 of output. Thereafter, greenhouse gases emissions increase with increase in SDA. The turning point is within the study data range but is far above individual countries’ averages and yearly averages in SSA region.

In the scatter plots presented in figures 4.1 (b) and 4.1 (d), it is indicated that the quadratic functional form’s goodness of fit is much explained by the cross-sectional dimension of the SSA data (see figure 4.1 (d)). The time-series dimension illustrated in figure 4.1 (b) indicates a non-clearly defined relationship between greenhouse gases emissions and sustainable development assistance in SSA countries over time. So the quadratic model discussed in this section derives its power from the cross-sectional dimension. However, the turning point of this quadratic functional model is almost two times bigger than the one suggested in the scatter plot of figure 4.1 (d). The reason could be that the scatter plot in figure 4.1 (d) only considers cross-sectional dimension and one explanatory variable, SDAPGDP. This relationship can be expressed as:

(4.5.1) $GHGEMPGDP = f(SDAPGDP)$

In the estimated quadratic model both the cross-sectional and time-series dimensions are considered and more explanatory variables are included. Increases in energy use, per capita income, and manufacturing share will increase greenhouse gases emissions. These three factors also grow with time. Therefore, besides their direct impact on

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[9] Turning point is the point at which the slope of the curve is zero. In a “U” curve the turning point defines the point where the gradient of the curve changes from negative to positive.

GHGEMPGDP, the three factors and the time dimension might also reduce the impact of SDAPGDP on reducing GHGEMPGDP. These factors are likely to be the shifting factors of the turning point suggested in figure 4.1 (d) to the one in the quadratic model in appendix B (III). Let the aggregate impact of these factors on SDAPGDP be $-\delta$ ($\delta>0$) and let their direct impact on GHGEMPGDP which is independent of SDAPGDP be π, then the quadratic model in appendix B (III) can be viewed as a shift of the function in (4.5.1) into:

(4.5.2) $GHGEMPGDP = f(SDAPGDP - \delta) + \pi$

This quadratic curve therefore looks like a combination of a horizontal shift to the right of the figure 4.1 (d)-scatter plot represented by function (4.5.1) by δ units and a vertical shift of the minimum value by π units (an upward shift if $\pi>0$, a downward shift if $\pi<0$ and no change in the minimum value if $\pi=0$). A detailed discussion on shifting graphs can be found in mathematics literature (Sydsæter, K and P. Hammond: 2002). Hence δ is the difference between the turning point of the quadratic model presented in appendix B (III) and the turning point suggested by the scatter plot of figure 4.1 (d). Figure 4.5 in appendix B (III) illustrates the sketches of the quadratic curves represented by the model in appendix B (III) and suggested by the scatter plot in figure 4.1 (d), assuming that $\pi>0$.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY OF THE STUDY

The study empirically investigates the impact of financial SDA, per capita income, manufacturing share and energy use on greenhouse gases emissions in SSA countries. The main objective is to find out whether sustainable development assistance reduces greenhouse gases emissions or increases these emissions in SSA countries. The random effects estimation procedure finds no evidence that in SSA region, SDA reduces greenhouse gases emissions although its coefficient has the expected negative sign. But in some individual countries like Zimbabwe the coefficient has a positive sign. In the quadratic functional form in terms of SDA variable, the coefficients are jointly significant at the 1% level, implying that the impact of SDA on environmental air quality depends on the size of the SDA a country receives. The study finds evidence that before the turning point explained in section 4.5, increases in SDA reduce greenhouse gases emissions in SSA countries and thereafter, increases in SDA increase emissions. Therefore, the study finds no evidence that greenhouse gases emission in SSA countries linearly decrease with increases in SDA and its lags. In the assumed dynamics, the dynamic random effects estimation procedure finds no evidence of a significant impact of previous period greenhouse gases emissions on current emissions despite the existence of a priori expected positive sign of the autoregressive coefficient.

The random effects results provide evidence that Gross Domestic Product per capita, manufacturing share and energy use are significant determinants of environmental air quality in SSA countries. In the linear model of section 4.3, per capita income variable is significant at the 5% level while the study finds no evidence of a significant impact of the lagged variables of per capita income on environmental air quality in SSA. Energy use is significant at the 1% level whereas manufacturing share is significant at the 5% level.

These variables are also significant in the quadratic model of section 4.5. The study findings provide no evidence to reject the main hypothesis of the study that SDA weakly reduces greenhouse gases emissions in poor countries. Both the linear and quadratic functional forms provide evidence that environmental air quality in SSA deteriorates steadily with increases in per capita income, energy use and manufacturing share.

The study is limited to a sample of SSA countries instead of the preferred population because of missing data for some countries. Although the study is restricted to a sample of 28 SSA countries because of data unavailability, the sample contains more than 60% of the SSA countries, making it large enough to be a reliable representative of the region. The major limitation of the study pertains to the non-inclusion of variables which are thought to be important causes of the ineffectiveness of SDA in poor countries, variables such as political instability, corruption levels, research expenditure and technological growth. These variables could not be included in the study because of the unavailability of the time series data. Hence the study is only limited to explaining whether SDA improves environmental quality in SSA or worsens it and not to explaining the causes of the ineffectiveness of SDA in improving environmental quality in SSA.

The other limitation of the study is that only one indicator of the environmental quality, greenhouse gases emissions, has been considered. There are several indicators of environmental quality which include oxygen regime in river basins, fecal contamination of river basins, and contamination of river basins by heavy metals, and dust particles in air. So there is great risk in generalizing the study’s findings to environmental quality. However, greenhouse gases emissions make a reasonable proxy measure for air pollution, giving the findings credibility in explaining the efficacy of SDA on environmental air quality in SSA countries.

5.2 POLICY RECOMMENDATIONS

The findings in chapter four provide an insight into how financial SDA influences greenhouse gases emissions in SSA countries. In view of these findings, it is evidenced that increases in financial SDA improves environmental quality in SSA countries with average SDAPGDP below US$0.338 in a US$1 unit of output. The researcher therefore recommends that developed countries should continue with their policy of financing sustainable development in these countries since most of these countries' average SDAPGDP is far below the turning point of US$0.338. In particular, the study recommends financial sustainable development assistance to be directed towards those countries with average SDAPGDP below the turning point, that is, the provision of SDA should depend on the receiving country's current size of assistance.

The theoretical framework of chapter five argues that ineffectiveness might be either a result of the developed countries demanding higher than optimal environmental quality from poor countries in the absence of moral hazard or a result of governments of poor countries producing greater than optimal output in the presence of moral hazard. In the case that the former is the cause of ineffectiveness of SDA, the study recommends the assistance providers to review their demands for environmental quality and if the later is the cause of ineffectiveness, it is recommended that the growth of non-state actors be encouraged and made the administrators of the financial assistance in poor countries.

5.3 SUGGESTIONS FOR FUTURE RESEARCHES

The researcher suggests that future studies on the efficacy of SDA on environmental quality in SSA countries should include social variables such as education, corruption levels, policy ratings and other endowment variables such as climate and all indicators of environmental quality. The researcher also suggests that future researchers should consider a variety of functional forms of the applied methodology and a variety of environmental quality indicators such as fecal, and heavy metal contamination of river basins and dust particles in air.

5.4 A SUGGESTED MODEL OF ENVIRONMENTAL FINANCING

In the case of ineffectiveness caused by developing countries, the researcher also suggests a model of post-cure[10] financial assistance, in which developing countries only obtain financial SDA from developed countries (as compensation to output loss due to the effort diverted from output production to environmental air quality improvements) if there is evidence of an improvement in environmental quality. Such assistance is dependent upon the effort put by the receiver in improving environmental quality. Assistance provided in this way cannot be abused by developing countries because it is only provided after the effort has already been applied. The model assumes that developing countries seek to maximize utility through the optimal allocation of effort between environmental financial assistance generating activities and all other output growth activities. Let Q be the given level of environmental quality. Suppose the developing country gives out α fraction of its effort to improve the environmental quality and use the rest of the remaining effort $(1-\alpha)$ on all other activities like output production. The quality of the environment will depend on α, that is;

(5.2.1) $Q = f(\alpha)$

Let also S be the size of the financial assistance given to a developing country by developed countries. According to the post-cure model, S depends on how much effort or environmental improvements have been achieved by the developing country in question. Financial assistance, S, is therefore a proportion of the environmental quality value. Suppose the developed country provides λ fraction of Q as the financial assistance size, then;

(5.2.2) $S = \lambda Q = \lambda f(\alpha)$

By applying effort in environmental activities, the country derives utility from the financial reward S and improved Q. However, in this model it is assumed that poor countries derive insignificant utility from environmental air quality improvements hence their utility function can be expressed as;

(5.2.3) $U = U(S) = U(\lambda Q) = U(\lambda f(\alpha))$

---

[10] Post-cure refers to "after treatment." Thus, post-cure sustainable development assistance is the assistance given to developing countries to compensate their effort in improving environmental air quality.

In applying effort, developing countries also incur some effort costs, $C(\alpha)$. Such costs are considered in utility maximization. Like the receivers of the assistance, rich countries also seek to maximize the benefits from the proceeds of the financial assistance they give out. The benefit Q is expressed in monetary terms $M(Q)$. So the rich country or the assistance provider maximizes its expected benefit;

(5.2.4) $\mathrm{E}\left[M(Q) - S\right] = \mathrm{E}\left[M(f(\alpha)) - S\right]$

subject to the poor country or the assistance receiver's participation constraint (PC),

(5.2.5) $\mathrm{E}\left[U(\lambda f(\alpha))\right]$ - $C(\alpha) \geq U^*$

and its incentive compatibility constraint (ICC), given by the first order condition for the choice of effort given λ, that is, the first order condition of the PC in (5.2.5) is sufficient for the ICC.

(5.2.6) $\mathrm{E}\lambda\left[U^{/}(\lambda f(\alpha))\right] f^{/}(\alpha) - C^{/}(\alpha) = 0$

Or $\mathrm{E}\lambda\left[U^{/}(\lambda f(\alpha))\right] f^{/}(\alpha) = C^{/}(\alpha)$

Condition (5.2.6) states that the optimal effort put by developing countries in environmental purification occur when the expected marginal utility from the financial assistance is equal to the marginal cost of effort. The optimal effort size therefore depends on the size of λ which ranges from 0 to 1 (λ = [0, 1]). The larger is λ the larger is the incentive for developing countries to increase effort in environmental management. If λ = 0 then there is zero financial assistance and developing countries tend to apply insignificant effort in environmental quality improvements. On the other hand if λ = 1 then whatever improvement in environmental quality made by the poor country will be fully financed through the assistance. In this case of full financing, developing countries are fully compensated for the forgone output growth (the opportunity cost of environmental air quality improvements). Maximum effort is therefore achieved when λ = 1 and falling as λ falls below 1.

In summary the post-cure environmental financial assistance model stipulates that financial assistance given to developing countries for environmental quality improvements achieves its objective if supplied as a function of the effort contributed by the receiving country in environmental quality improvements. The greater is the proportion of the financial assistance in covering the contribution costs the greater is the effort applied in environmental quality improvements by these countries. The model is derived from the Marshallian productivity theory which states that the labour supplier applies more effort when he knows that all the benefits from the marginal unit of effort is accrued to himself than when he receives only partial benefits of the marginal unit of effort. In other words the Marshallian model which assumes the presence of prohibitive monitoring costs by the assistance providers would predict financial sustainable development assistance supplied with $\lambda = 1$ to be more efficient than the one supplied with $\lambda < 1$ (Bardhan and Udry, 1999). Despite its attractive flavor, the post-cure environmental financial assistance model is not common in this field. It is therefore left for future studies to test Marshall's proposition that predicts financial assistance supplied with $\lambda = 1$ to be more efficient than the one supplied with $\lambda < 1$.

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APPENDIX A

Table 4.1 (b) extension
More year-specific summary statistics (For every 5th year starting from 1971 in ascending order)

		Obs	***Mean***	***Std. Dev***	***Min***	***Max***
1971	***GHGEMPGDP***	28	0.001107	0.001095	0.000031	0.004150
	SDAPGDP	28	0.018253	0.013525	0.000000	0.049341
	ENUSEPGDP	28	1.420655	0.963500	0.494179	4.739638
	GDPPCAP	28	599.3057	755.2459	133.7900	3193.660
	MANSHARE	28	0.098929	0.046295	0.030000	0.220000
		Obs	***Mean***	***Std. Dev***	***Min***	***Max***
1976	***GHGEMPGDP***	28	0.001108	0.001100	0.000029	0.004519
	SDAPGDP	28	0. 045307	0. 054539	0.000000	0.298466
	ENUSEPGDP	28	1.299296	0.806730	0.264658	4.022226
	GDPPCAP	28	801.1729	1479.396	153.3300	7714.230
	MANSHARE	28	0.100357	0.047413	0.030000	0.230000
		Obs	***Mean***	***Std. Dev***	***Min***	***Max***
1981	***GHGEMPGDP***	28	0.001204	0.001019	0.000042	0.003604
	SDAPGDP	28	0.086281	0.076553	0.000000	0.305495
	ENUSEPGDP	28	1.266073	0.699255	0.431182	3.353255
	GDPPCAP	28	714.9979	1030.951	136.2200	4779.750
	MANSHARE	28	0.100714	0.053050	0.040000	0.240000
		Obs	***Mean***	***Std. Dev***	***Min***	***Max***
1986	***GHGEMPGDP***	28	0.000929	0.001088	0.000036	0.004426
	SDAPGDP	28	0.119158	0.097027	0.000000	0.390870
	ENUSEPGDP	28	1.332321	0.871340	0.384801	4.475210
	GDPPCAP	28	686.9416	951.5968	120.8700	4352.960
	MANSHARE	28	0.103929	0.051950	0.040000	0.250000

		Obs	*Mean*	*Std. Dev*	*Min*	*Max*
1991	***GHGEMPGDP***	28	0.000892	0.001193	0.000034	0.004432
	SDAPGDP	28	0.170730	0.128428	0.000000	0.445602
	ENUSEPGDP	28	1.330119	0.714735	0.307262	2.994646
	GDPPCAP	28	673.6414	963.5600	108.060	4189.780
	MANSHARE	28	0.115000	0.073055	0.040000	0.370000
		Obs	*Mean*	*Std. Dev*	*Min*	*Max*
1996	***GHGEMPGDP***	28	0.001036	0.001114	0.000034	0.003923
	SDAPGDP	28	0.167061	0.235823	0.003070	1.272498
	ENUSEPGDP	28	1.376065	0.795320	0.263414	3.650126
	GDPPCAP	28	653.9950	969.3118	59.45000	4147.480
	MANSHARE	28	0.100357	0.047880	0.030000	0.200000

Table 4.1 (c) extension
More country-specific summary statistics (For every 5th country in the study in alphabetical arrangement)

		Obs	*Mean*	*Std. Dev*	*Min*	*Max*
Angola (co=1)	***GHGEMPGDP***	31	0.00115	0.000355	0.000719	0.002279
	SDAPGDP	31	0.021839	0.021156	0.000000	0.073692
	ENUSEPGDP	31	0.836640	0.177272	0.640392	1.269719
	GDPPCAP	31	713.6216	119.9625	504.2100	889.0800
	MANSHARE	31	0.080000	0.027568	0.030000	0.120000
		Obs	*Mean*	*Std. Dev*	*Min*	*Max*
Chad (co=6)	***GHGEMPGDP***	31	0.000215	0.000113	0.000067	0.000474
	SDAPGDP	31	0.137629	0.068528	0.027117	0.282614
	ENUSEPGDP	31	1.006367	0.113513	0.757915	1.194107
	GDPPCAP	31	181.8132	20.56021	141.1100	219.4200
	MANSHARE	31	0.113548	0.016643	0.080000	0.150000

		Obs	***Mean***	***Std. Dev***	***Min***	***Max***
Gabon (co=11)	***GHGEMPGDP***	31	0.001933	0.000898	0.000400	0.003829
	SDAPGDP	31	0.018795	0.009935	0.002365	0.042599
	ENUSEPGDP	31	0.411347	0.112474	0.264658	0.687477
	GDPPCAP	31	4389.680	943.2392	2956.320	7714.230
	MANSHARE	31	0.057097	0.015957	0.040000	0.090000
		Obs	***Mean***	***Std. Dev***	***Min***	***Max***
Madag (co=16)	***GHGEMPGDP***	31	0.000506	0.000124	0.000289	0.000790
	SDAPGDP	31	0.079018	0.050586	0.016071	0.244809
	ENUSEPGDP	31	1.450851	0.171812	1.133011	1.813975
	GDPPCAP	31	295.1626	58.67077	228.3400	410.0600
	MANSHARE	31	0.110968	0.011360	0.080000	0.130000
		Obs	***Mean***	***Std. Dev***	***Min***	***Max***
Nigeria (co=21)	***GHGEMPGDP***	31	0.002380	0.001720	0.000000	0.005162
	SDAPGDP	31	0.003980	0.002641	0.000233	0.010872
	ENUSEPGDP	31	1.940036	0.272745	1.469602	2.437888
	GDPPCAP	31	397.3871	43.12438	322.0000	480.0000
	MANSHARE	31	0.060000	0.022657	0.030000	0.110000
		Obs	***Mean***	***Std. Dev***	***Min***	***Max***
Togo (co=26)	***GHGEMPGDP***	31	0.000072	0.000056	0.000000	0.000218
	SDAPGDP	31	0.109893	0.058730	0.027677	0.242296
	ENUSEPGDP	31	1.212278	0.223180	0.921965	1.640394
	GDPPCAP	31	281.1613	32.07813	203.0000	346.0000
	MANSHARE	31	0.081290	0.016277	0.060000	0.120000

Table 4.2 (b)

The country-specific correlation matrix (Example: Zimbabwe-randomly selected)

$gdppcap_{t-2}$									1.0000
$Gdppcap_{t-1}$								1.0000	0.6965
$sdapgdp_{t-2}$							1.0000	-0.4801	-0.8151
$sdapgdp_{t-1}$						1.0000	0.5643	-0.7417	-0.4626
manshare					1.0000	0.0980	-0.1151	0.0068	0.0709
gdppcap				1.0000	-0.2303	-0.1197	0.0600	-0.3771	0.0056
enusepgdp			1.0000	-0.5400	0.2023	-0.0286	0.0178	-0.3862	-0.2774
sdapgdp		1.0000	-0.2931	-0.2375	0.6445	0.3146	0.1055	0.0715	0.1633
ghgempgd	1.0000	0.2548	0.3499	-0.0959	0.4319	0.3240	0.3515	-0.2300	-0.1988
	ghgempgd	***sdapgdp***	***enusepgdp***	***gdppcap***	***manshare***	***$sdapgdp_{t-1}$***	***$sdapgdp_{t-2}$***	***$gdppcap_{t-1}$***	***$gdppcap_{t-2}$***

Table 4.2 (c)

The period-specific correlation matrix (Example: 2000-randomly selected)

	ghgempgd	***sdapgdp***	***enusepgdp***	***gdppcap***	***manshare***	$sdapgdp_{t-1}$	$sdapgdp_{t-2}$	$gdppcap_{t-1}$	$gdppcap_{t-2}$
$gdppcap_{t-2}$									1.0000
$Gdppcap_{t-1}$								1.0000	0.9974
$sdapgdp_{t-2}$							1.0000	-0.4829	-0.4829
$sdapgdp_{t-1}$						1.0000	0.9228	-0.4777	-0.4759
manshare					1.0000	0.0828	0.1554	-0.0472	-0.0544
gdppcap				1.0000	-0.0595	-0.4745	-0.4806	0.9992	0.9942
enusepgdp			1.0000	-0.5480	-0.0780	0.4069	0.4087	-0.5486	-0.5437
sdapgdp		1.0000	0.4274	-0.4629	0.0871	0.9417	0.8685	-0.4648	-0.4637
ghgempgd	1.0000	-0.0500	-0.1235	0.2480	0.3265	-0.0499	-0.0839	0.2551	0.2414

APPENDIX B (I)

Panel Regressions and The Hausman Test

```
tsset co yr
panel variable:  co, 1 to 28
time variable:  yr, 1970 to 2000
```

.xtreg ghgempgdp sdapgdp enusepgdp gdppcap manshare sdapgdp$_{t-1}$ sdapgdp$_{t-2}$ gdppcap$_{t-1}$ gdppcap$_{t-2}$,fe

```
Fixed-effects (within) regression            Number of obs     =      866
Group variable (i): co                        Number of groups =       28

R-sq:  within  = 0.0289                      Obs per group: min  =       29
       between = 0.1832                                     avg =     30.9
         overall = 0.1063                                   max =       31

F(8,830)          =      3.09
  corr(u_i, Xb)  = 0.0861                       Prob > F          =    0.0019


ghgempgdp    Coef.        Std. Err.      t        P>t     [95% Conf. Interval]
sdapgdp       6.90e-06    .0005438     0.01   0.990    -.0010604    .0010742
enusepgdp    .0004509   .0000969     4.65   0.000     .0002606    .0006411
gdppcap       2.23e-07    1.69e-07     1.32   0.186   -1.08e-07      5.55e-07
manshare     .0018303    .0011853     1.54   0.123   -.0004963     .0041569
sdapgdp_{t-1} -.0001813  .0006525    -0.28   0.781   -.0014621     .0010995
sdapgdp_{t-2} -.0002076  .0005315    -0.39   0.696   -.0012507     .0008356
gdppcap_{t-1} -2.47e-08    1.72e-07    -0.14   0.886   -3.62e-07     3.13e-07
gdppcap_{t-2}  4.35e-08   1.21e-07     0.36   0.719    -1.93e-07      2.80e-07
_cons          .0001619    .0002249     0.72   0.472   -.0002796     .0006035

sigma_u   .00083778
sigma_e   .00090303
rho   .46257076   (fraction of variance due to u_i)
F test that all u_i=0:     F(27, 830) =    20.46            Prob > F = 0.0000

. est store fixed
```

. xtreg ghgempgdp sdapgdp enusepgdp gdppcap manshare sdapgdp1 sdapgdp2 gdppcap1 gdppcap2,re

```
Random-effects GLS regression           Number of obs     =      866
Group variable (i): co                  Number of groups   =       28
 R-sq:  within  = 0.0267                Obs per group: min = 29
```

between = 0.3101 avg = 30.9
overall = 0.1676 max = 31

Random effects u_i ~ Gaussian Wald chi2(8) = 36.41
corr(u_i, X) = 0 (assumed) Prob > chi2 = 0.0000

ghgempgdp	***Coef.***	***Std. Err.***	***z***	***P>z***	***[95% Conf.***	***Interval]***
sdapgdp	-.0000223	.000545	-0.04	0.967	-.0010904	.0010458
enusepgdp	.0004262***	.0000882	4.83	0.000	.0002533	.000599
gdppcap	3.60e-07**	1.50e-07	2.39	0.017	6.50e-08	6.54e-07
manshare	.0028174**	.0010948	2.57	0.010	.0006717	.0049631
sdapgdp$_{t-1}$	-.0001676	.0006562	-0.26	0.798	-.0014536	.0011185
sdapgdp$_{t-2}$	-.0001754	.0005337	-0.33	0.742	-.0012216	.0008707
gdppcap$_{t-1}$	-3.64e-08	1.73e-07	-0.21	0.833	-3.75e-07	3.02e-07
gdppcap$_{t-2}$	5.84e-08	1.21e-07	0.48	0.630	-1.79e-07	2.96e-07
_cons	-3.70e-06	.0002357	-0.02	0.987	-.0004657	.0004583

sigma_u .00066573
sigma_e .00090303
rho .35211889 (fraction of variance due to u_i)

hausman fixed

---- Coefficients ----

	(b) ***fixed***	***(B)*** ***.***	***(b-B)*** ***Difference***	***sqrt(diag(V_b-V_B))*** ***S.E.***
sdapgdp	6.90e-06	-.0000223	.0000292	.
enusepgdp	.0004509	.0004262	.0000247	.0000402
gdppcap	2.23e-07	3.60e-07	-1.36e-07	7.67e-08
manshare	.0018303	.0028174	-.0009871	.0004545
sdapgdp$_{t-1}$	-.0001813	-.0001676	-.0000137	.
sdapgdp$_{t-2}$	-.0002076	-.0001754	-.0000321	.
gdppcap$_{t-}$	-2.47e-08	-3.64e-08	1.17e-08	.
gdppcap$_{t-2}$	4.35e-08	5.84e-08	-1.49e-08	

b = $\overset{\wedge}{\beta}_{Within}$ = consistent under Ho and Ha; obtained from xtreg

B = $\overset{\wedge}{\beta}_{GLS}$ = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic
chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
=7.89
Prob>chi2 = 0.2463

APPENDIX B (II)

The Dynamic Random Effects Model

. xtivreg ∆ghgempgdp (∆ghgempgdp$_{t-1}$= ghgempgdp$_{t-2}$ ghgempgdp$_{t-3}$ ∆ghgempgdp$_{t-3}$) sdapgdp enusepgdp gdppcap manshare sdapgdp$_{t-1}$ sdapgdp$_{t-2}$ gdppcap$_{t-1}$ gdppcap$_{t-2}$, re

```
G2SLS random-effects IV regression            Number of obs      =  864
Group variable: co                           Number of groups   =  28

R-sq:  within  = 0.0541                      Obs per group: min = 27
       between = 0.4741                                     avg = 30.9
        overall = 0.0461                                    max = 31

Wald chi2(9) = 8.11
 corr(u_i, X)  = 0 (assumed)                   Prob > chi2       =    0.5235

------------------------------------------------------------------------------
  ∆ghgempgdp        Coef.     Std. Err.     z       P>z     [95% Conf. Interval]
-------------+----------------------------------------------------------------
∆ghgempgdp_t-1.  .0802543   .0662643     1.21   0.226   -.0496214    .2101299
Sdapgdp          .0003523   .0006256     0.56   0.573   -.0008739    .0015785
enusepgdp       -.0000247   .0000522    -0.47   0.637   -.0001271    .0000777
gdppcap          3.04e-07** 1.42e-07     2.14   0.033    2.53e-08    5.82e-07
manshare         .0006431   .0006905     0.93   0.352   -.0007103    .0019965
sdapgdp_t-1     -.0003703   .0007717    -0.48   0.631   -.0018828    .0011422
sdapgdp_t-2      .0000534   .0006229     0.09   0.932   -.0011675    .0012744
gdppcap_t-1     -3.72e-07*  2.04e-07    -1.82   0.068   -7.73e-07    2.82e-08
gdppcap_t-2      5.57e-08   1.43e-07     0.39   0.697   -2.24e-07    3.36e-07
_cons           -.0000274   .0001198    -0.23   0.819   -.0002622    .0002074
-------------+----------------------------------------------------------------
     sigma_u =  0
     sigma_e = .00110981
         rho =  0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Instrumented: ***∆ghgempgdp$_{t-1}$***

Instrumented: is followed by the list below.

Instruments: ***sdapgdp, enusepgdp, gdppcap, manshare, sdapgdp$_{t-1}$, sdapgdp$_{t-2}$, gdppcap$_{t-1}$, gdppcap$_{t-2}$, ghgempgdp$_{t-2}$, ghgempgdp$_{t-3}$, ∆ghgempgdp$_{t-3}$***

APPENDIX B (III)

The Quadratic Functional Form

xtreg ghgempgdp sdapgdp enusepgdp gdppcap manshare $sdapgdp_{t-1}$ $sdapgdp_{t-2}$ $gdppcap_{t-1}$ $gdppcap_{t-2}$ $sdapgdp^2$ $gdppcap^2$ $gdppcap_{t-1}^2$ $gdppcap_{t-2}^2$ $sdapgdp_{t-1}^2$ $sdapgdp_{t-2}^2$, re

Random-effects GLS regression Number of obs = 866
Group variable (i): co Number of groups = 28

R-sq: within = 0.0392 Obs per group: min = 29
between = 0.3859 avg = 30.9
overall = 0.2121 max = 31
Random effects u_i ~ Gaussian Wald chi2(14) = 43.24
corr(u_i, X) = 0 (assumed) Prob > chi2 = 0.0001

ghgempgdp	***Coef.***	***Std. Err.***	***z***	***P>z***	***[95% Conf.***	***Interval]***
sdapgdp	-.0013473	.0010875	-1.24	0.215	-.0034787	.0007841
enusepgdp	$.0003998^{***}$	.0000976	4.10	0.000	.0002085	.0005911
gdppcap	$7.43e-07^{**}$	2.88e-07	2.58	0.010	1.79e-07	1.31e-06
manshare	$.002953^{***}$	.0011067	2.67	0.008	.0007839	.0051221
$sdapgdp_{t-1}$	-.0004833	.0013659	-0.35	0.723	-.0031604	.0021939
$sdapgdp_{t-2}$	-.0000507	.0010989	-0.05	0.963	-.0022045	.0021032
$gdppcap_{t-1}$	3.50e-08	3.07e-07	0.11	0.909	-5.67e-07	6.37e-07
$gdppcap_{t-2}$	-2.05e-07	2.32e-07	-0.88	0.376	-6.59e-07	2.49e-07
$sdapgdp^2$	$.0019917^{**}$	.001012	1.97	0.049	8.17e-06	.0039752
$gdppcap^2$	-6.47e-11	4.21e-11	-1.54	0.124	-1.47e-10	1.78e-11
$gdppcap_{t-1}^2$	-1.36e-11	5.16e-11	-0.26	0.791	-1.15e-10	8.74e-11
$gdppcap_{t-2}^2$	4.57e-11	3.93e-11	1.16	0.246	-3.14e-11	1.23e-10
$sdapgdp_{t-1}^2$	.0005301	.0011802	0.45	0.653	-.001783	.0028432
$sdapgdp_{t-2}^2$	.0001448	.0010346	0.14	0.889	-.0018829	.0021725
_cons	.0000225	.0002859	0.08	0.937	-.000538	.0005829

sigma_u .00072635
sigma_e .00090102
rho .39388878 (fraction of variance due to u_i)

. ***test sdapgdp = enusepgdp = gdppcap = manshare =*** $sdapgdp_{t-1} = sdapgdp_{t-2} = gdppcap_{t-1} = gdppcap_{t-2} = sdapgdp^2 = gdppcap^2 = gdppcap_{t-1}^2 = gdppcap_{t-2}^2 = sdapgdp_{t-1}^2 = sdapgdp_{t-2}^2 = 0$

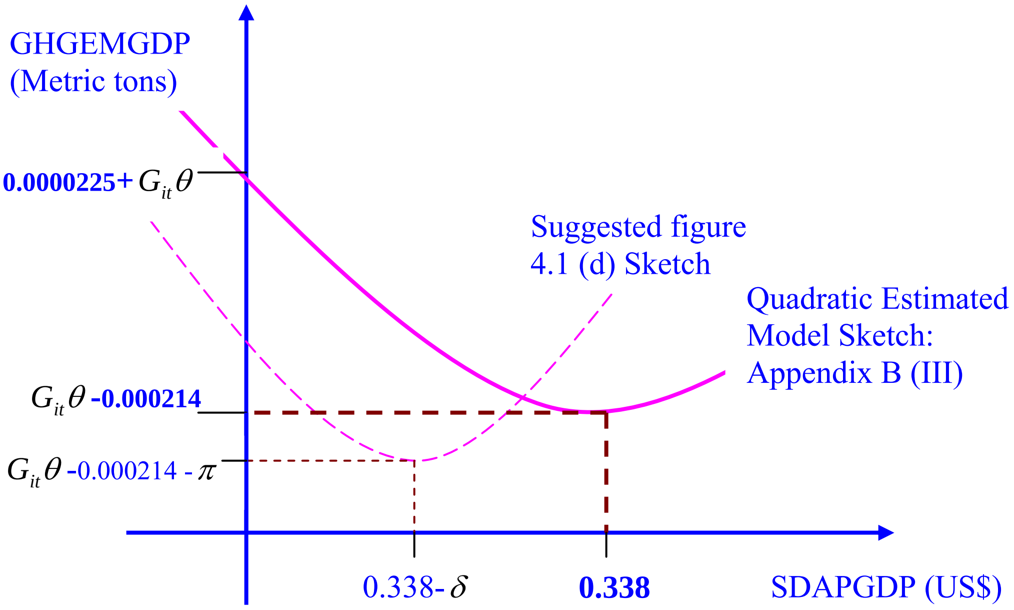
(1) sdapgdp - enusepgdp = 0
(2) sdapgdp - gdppcap = 0
(3) sdapgdp - manshare = 0
(4) sdapgdp - sdapgdp1 = 0
(5) sdapgdp - sdapgdp2 = 0

```
( 6)  sdapgdp - gdppcap1 = 0
( 7)  sdapgdp - gdppcap2 = 0
( 8)  sdapgdp - sdapgdpSQ = 0
( 9)  sdapgdp - gdppcapSQ = 0
(10)  sdapgdp - gdppcap1SQ = 0
(11)  sdapgdp - gdppcap2SQ = 0
(12)  sdapgdp - sdapgdp1SQ = 0
(13)  sdapgdp - sdapgdp2SQ = 0
(14)  sdapgdp = 0
Constraint 10 dropped
Constraint 11 dropped
Constraint 14 dropped

chi2( 11) =   43.24
Prob > chi2 =    0.0000
```

Figure 4.5

Sketched graphs of the quadratic function



The Cubic Functional Form

xtreg ghgempgdp sdapgdp enusepgdp gdppcap manshare sdapgdp$_{t-1}$ sdapgdp$_{t-2}$ gdppcap$_{t-1}$ gdppcap$_{t-2}$ sdapgdp^2 sdapgdp^3 gdppcap^2 gdppcap^3 gdppcap$_{t-1}^2$ gdppcap$_{t-2}^2$ gdppcap$_{t-1}^3$ sdapgdp$_{t-1}^2$ sdapgdp$_{t-2}^2$ sdapgdp$_{t-1}^3$,re

Random-effects GLS regression Number of obs = 866
Group variable (i): co Number of groups = 28

R-sq: within = 0.0433 Obs per group: min = 29
between = 0.4271 avg = 30.9
overall = 0.2335 max = 31

Random effects u_i ~ GaussianWald chi2(18) = 45.03
corr(u_i, X) = 0 (assumed) Prob > chi2 = 0.0004

ghgempgdp	***Coef.***	***Std. Err.***	***z***	***P>z***	***[95% Conf.***	***Interval]***
sdapgdp	-.0007783	.0017593	-0.44	0.658	-.0042265	.0026698
enusepgdp	.0004741***	.0001071	4.43	0.000	.0002642	.000684
gdppcap	9.13e-07	7.27e-07	1.26	0.209	-5.12e-07	2.34e-06
manshare	.0029404***	.001105	2.66	0.008	.0007746	.0051062
sdapgdp$_{t-1}$	-.0018004	.0020368	-0.88	0.377	-.0057925	.0021918
sdapgdp$_{t-2}$	.0001314	.0011079	0.12	0.906	-.00204	.0023028
gdppcap$_{t-1}$	7.55e-07	7.31e-07	1.03	0.301	-6.77e-07	2.19e-06
gdppcap$_{t-2}$	-2.68e-07	2.38e-07	-1.13	0.260	-7.35e-07	1.98e-07
sdapgdp^2	.0005924	.0044508	0.13	0.894	-.0081311	.0093158
sdapgdp^3	.0006092	.002746	0.22	0.824	-.0047728	.0059912
gdppcap^2	-1.43e-10	2.56e-10	-0.56	0.577	-6.45e-10	3.59e-10
gdppcap^3	8.99e-15	2.15e-14	0.42	0.676	-3.31e-14	5.11e-14
gdppcap$_{t-1}^2$	-3.01e-10	2.60e-10	-1.16	0.246	-8.10e-10	2.08e-10
gdppcap$_{t-2}^2$	7.00e-11	4.28e-11	1.63	0.102	-1.40e-11	1.54e-10
gdppcap$_{t-1}^3$	2.45e-14	2.08e-14	1.18	0.239	-1.63e-14	6.53e-14
sdapgdp$_{t-1}^2$	.0051823	.0048247	1.07	0.283	-.0042739	.0146385
sdapgdp$_{t-2}^2$	.0001435	.0010394	0.14	0.890	-.0018937	.0021807
sdapgdp$_{t-1}^3$	-.0030503	.0030154	-1.01	0.312	-.0089604	.0028598
_cons	-.0003228	.0003669	-0.88	0.379	-.0010419	.0003963

sigma_u .0007076
sigma_e .00090118
rho .38139176 (fraction of variance due to u_i)

APPENDIX C

Table C: Study Data

Country	yr	co	ghgempgdp	sdapgdp	enusepgdp	gdppcap	manshare	Sdapgdp$_{t-1}$	sdapgdp$_{t-2}$	gdppcap$_{t-1}$	gdppcap$_{t-2}$
Angola	1970	1	0.00155	0	1.26972	504.34	0.12				
	1971	1	0.00145	0	1.25394	504.21	0.11	0		504.34	
	1972	1	0.00152	0.00002	1.06889	623.71	0.12	0	0	504.21	504.34
	1973	1	0.00149	0.00003	0.65287	671.34	0.11	0.00002	0	623.71	504.21
	1974	1	0.00147	0.00009	0.97858	661.91	0.1	0.00003	0.00002	671.34	623.71
	1975	1	0.00120	0.00010	0.85910	721.87	0.1	0.00009	0.00003	661.91	671.34
	1976	1	0.00079	0.00313	0.73968	799.63	0.1	0.00010	0.00009	721.87	661.91
	1977	1	0.00074	0.00745	0.64039	889.08	0.09	0.00313	0.00010	799.63	721.87
	1978	1	0.00113	0.00730	0.70348	870.7	0.1	0.00745	0.00313	889.08	799.63
	1979	1	0.00110	0.00704	0.68804	881.13	0.1	0.00730	0.00745	870.7	889.08
	1980	1	0.00107	0.00777	0.69490	861.05	0.09	0.00704	0.00730	881.13	870.7
	1981	1	0.00113	0.00992	0.74716	779.19	0.11	0.00777	0.00704	861.05	881.13
	1982	1	0.00099	0.00936	0.73528	752.07	0.09	0.00992	0.00777	779.19	861.05
	1983	1	0.00098	0.01123	0.72540	756.34	0.09	0.00936	0.00992	752.07	779.19
	1984	1	0.00096	0.01339	0.70728	775.24	0.09	0.01123	0.00936	756.34	752.07
	1985	1	0.00087	0.01253	0.74431	778.18	0.08	0.01339	0.01123	775.24	756.34
	1986	1	0.00085	0.01755	0.73334	778.51	0.08	0.01253	0.01339	778.18	775.24
	1987	1	0.00097	0.01679	0.69863	819.66	0.11	0.01755	0.01253	778.51	778.18
	1988	1	0.00082	0.01857	0.68392	845.45	0.08	0.01679	0.01755	819.66	778.51
	1989	1	0.00078	0.01968	0.69522	828.15	0.06	0.01857	0.01679	845.45	819.66
	1990	1	0.00074	0.03140	0.74258	803.62	0.05	0.01968	0.01857	828.15	845.45
	1991	1	0.00072	0.03313	0.76175	770.58	0.06	0.03140	0.01968	803.62	828.15
	1992	1	0.00076	0.04414	0.82040	694.88	0.07	0.03313	0.03140	770.58	803.62
	1993	1	0.00136	0.04937	1.13130	506.57	0.08	0.04414	0.03313	694.88	770.58
	1994	1	0.00093	0.07369	1.12533	508.33	0.05	0.04937	0.04414	506.57	694.88
	1995	1	0.00228	0.06216	1.02171	545.5	0.06	0.07369	0.04937	508.33	506.57
	1996	1	0.00181	0.06166	0.94148	591.3	0.03	0.06216	0.07369	545.5	508.33
	1997	1	0.00106	0.04413	0.89520	623.21	0.03	0.06166	0.06216	591.3	545.5
	1998	1	0.00102	0.03906	0.82442	650.76	0.06	0.04413	0.06166	623.21	591.3
	1999	1	0.00101	0.04372	0.85724	656.42	0.03	0.03906	0.04413	650.76	623.21
	2000	1	0.00103	0.03261	0.79429	669.34	0.03	0.04372	0.03906	656.42	650.76
Benin	1970	2	0.00096	0.01771	1.26778	294.12	0.1	0.03261	0.04372	669.34	656.42
	1971	2	0.00108	0.03536	1.35479	282.79	0.11	0.01771	0.03261	294.12	669.34
	1972	2	0.00110	0.02299	1.33488	293.57	0.11	0.03536	0.01771	282.79	294.12
	1973	2	0.00106	0.02928	1.31260	296.77	0.11	0.02299	0.03536	293.57	282.79
	1974	2	0.01906	0.03538	1.29698	298.77	0.13	0.02928	0.02299	296.77	293.57
	1975	2	0.00098	0.06087	1.40424	276.67	0.12	0.03538	0.02928	298.77	296.77
	1976	2	0.00080	0.05661	1.35065	271.67	0.09	0.06087	0.03538	276.67	298.77
	1977	2	0.00074	0.05187	1.33649	277.45	0.09	0.05661	0.06087	271.67	276.67
	1978	2	0.00089	0.06332	1.37236	273.07	0.11	0.05187	0.05661	277.45	271.67
	1979	2	0.00088	0.08332	1.30983	282.41	0.09	0.06332	0.05187	273.07	277.45
	1980	2	0.00065	0.08138	1.25708	292.32	0.08	0.08332	0.06332	282.41	273.07
	1981	2	0.00048	0.06815	1.14746	311.07	0.07	0.08138	0.08332	292.32	282.41
	1982	2	0.00057	0.06539	1.16012	307.4	0.09	0.06815	0.08138	311.07	292.32
	1983	2	0.00072	0.07284	1.24891	284.04	0.09	0.06539	0.06815	307.4	311.07

	1984	2	0.00065	0.05962	1.18416	296.21	0.08	0.07284	0.06539	284.04	307.4
	1985	2	0.00075	0.06942	1.15518	307.97	0.08	0.05962	0.07284	296.21	284.04
	1986	2	0.00067	0.09743	1.14150	304.53	0.07	0.06942	0.05962	307.97	296.21
	1987	2	0.00051	0.09817	1.17428	290.51	0.07	0.09743	0.06942	304.53	307.97
	1988	2	0.00056	0.11220	1.16262	290.92	0.08	0.09817	0.09743	290.51	304.53
	1989	2	0.00064	0.19585	1.20627	273.43	0.08	0.11220	0.09817	290.92	290.51
	1990	2	0.00069	0.18904	1.18856	272.64	0.08	0.19585	0.11220	273.43	290.92
	1991	2	0.00074	0.17968	1.15186	275.38	0.08	0.18904	0.19585	272.64	273.43
	1992	2	0.00078	0.17496	1.13347	275.95	0.08	0.17968	0.18904	275.38	272.64
	1993	2	0.00098	0.18047	1.12382	275.23	0.08	0.17496	0.17968	275.95	275.38
	1994	2	0.00102	0.15400	1.10081	277.15	0.09	0.18047	0.17496	275.23	275.95
	1995	2	0.00101	0.16115	1.07539	280.29	0.09	0.15400	0.18047	277.15	275.23
	1996	2	0.00094	0.15689	1.18455	286.7	0.08	0.16115	0.15400	280.29	277.15
	1997	2	0.00102	0.11336	1.15448	295.44	0.09	0.15689	0.16115	286.7	280.29
	1998	2	0.00091	0.10084	1.09697	300.09	0.09	0.11336	0.15689	295.44	286.7
	1999	2	0.00097	0.09899	1.10125	305.18	0.09	0.10084	0.11336	300.09	295.44
	2000	2	0.00099	0.10575	0.89186	313.3	0.09	0.09899	0.10084	305.18	300.09
Botswana	1970	3	0.00003	0.04757	0.73128	397.92	0.04	0.10575	0.09899	313.3	305.18
	1971	3	0.00006	0.04700	0.60168	485.11	0.04	0.04757	0.10575	397.92	313.3
	1972	3	0.00007	0.06620	0.50207	593.36	0.04	0.04700	0.04757	485.11	397.92
	1973	3	0.00012	0.06267	0.44749	696.19	0.05	0.06620	0.04700	593.36	485.11
	1974	3	0.00018	0.05821	0.43666	732.31	0.05	0.06267	0.06620	696.19	593.36
	1975	3	0.00037	0.07502	0.75169	767.63	0.06	0.05821	0.06267	732.31	696.19
	1976	3	0.00107	0.06306	0.85209	820.9	0.07	0.07502	0.05821	767.63	732.31
	1977	3	0.00125	0.05614	0.79119	888.65	0.07	0.06306	0.07502	820.9	767.63
	1978	3	0.00117	0.07147	0.71694	981.93	0.07	0.05614	0.06306	888.65	820.9
	1979	3	0.00118	0.09212	0.66478	1064.3	0.08	0.07147	0.05614	981.93	888.65
	1980	3	0.00110	0.08711	0.62060	1152.02	0.05	0.09212	0.07147	1064.3	981.93
	1981	3	0.00103	0.07319	0.58876	1214.64	0.05	0.08711	0.09212	1152.02	1064.3
	1982	3	0.00101	0.06854	0.55061	1317.46	0.08	0.07319	0.08711	1214.64	1152.02
	1983	3	0.00083	0.06165	0.49142	1442.18	0.07	0.06854	0.07319	1317.46	1214.64
	1984	3	0.00078	0.05614	0.46209	1515.56	0.06	0.06165	0.06854	1442.18	1317.46
	1985	3	0.00081	0.04916	0.45603	1573.16	0.07	0.05614	0.06165	1515.56	1442.18
	1986	3	0.00085	0.04784	0.46245	1650.51	0.06	0.04916	0.05614	1573.16	1515.56
	1987	3	0.00088	0.06577	0.41122	1792.78	0.06	0.04784	0.04916	1650.51	1573.16
	1988	3	0.00078	0.05327	0.40649	2080.79	0.05	0.06577	0.04784	1792.78	1650.51
	1989	3	0.00076	0.04968	0.38408	2287.41	0.05	0.05327	0.06577	2080.79	1792.78
	1990	3	0.00086	0.04278	0.37474	2376.17	0.05	0.04968	0.05327	2287.41	2080.79
	1991	3	0.00079	0.03593	0.36490	2486.03	0.05	0.04278	0.04968	2376.17	2287.41
	1992	3	0.00118	0.02964	0.39585	2493.34	0.06	0.03593	0.04278	2486.03	2376.17
	1993	3	0.00123	0.03369	0.38841	2478.98	0.06	0.02964	0.03593	2493.34	2486.03
	1994	3	0.00118	0.02149	0.36951	2509.12	0.05	0.03369	0.02964	2478.98	2493.34
	1995	3	0.00114	0.02163	0.36238	2562.19	0.05	0.02149	0.03369	2509.12	2478.98
	1996	3	0.00096	0.01704	0.33325	2648.5	0.05	0.02163	0.02149	2562.19	2509.12
	1997	3	0.00090	0.02559	0.31786	2861.6	0.05	0.01704	0.02163	2648.5	2562.19
	1998	3	0.00097	0.01996	0.32539	3110.28	0.05	0.02559	0.01704	2861.6	2648.5
	1999	3	0.00083	0.01067	0.31119	3287.94	0.05	0.01996	0.02559	3110.28	2861.6
	2000	3	0.00091	0.00496	0.29819	3521.77	0.04	0.01067	0.01996	3287.94	3110.28
Camerun	1970	4	0.00027	0.01758	0.79589	508.54	0.1	0.00496	0.01067	3521.77	3287.94

	1971	4	0.00032	0.01382	0.78864	513.19	0.1	0.01758	0.00496	508.54	3521.77
	1972	4	0.00032	0.01754	0.78793	513.61	0.1	0.01382	0.01758	513.19	508.54
	1973	4	0.00033	0.01612	0.76324	527.16	0.1	0.01754	0.01382	513.61	513.19
	1974	4	0.00031	0.01480	0.70481	568.24	0.1	0.01612	0.01754	527.16	513.61
	1975	4	0.00033	0.02357	0.66001	614.81	0.1	0.01480	0.01612	568.24	527.16
	1976	4	0.00034	0.03073	0.70795	564.59	0.11	0.02357	0.01480	614.81	568.24
	1977	4	0.00041	0.03589	0.66984	623.55	0.12	0.03073	0.02357	564.59	614.81
	1978	4	0.00044	0.02945	0.56872	738.48	0.12	0.03589	0.03073	623.55	564.59
	1979	4	0.00037	0.04281	0.55739	760.31	0.08	0.02945	0.03589	738.48	623.55
	1980	4	0.00082	0.04177	0.58481	724.13	0.1	0.04281	0.02945	760.31	738.48
	1981	4	0.00097	0.02672	0.52400	824.25	0.1	0.04177	0.04281	724.13	760.31
	1982	4	0.00107	0.02657	0.50943	862.03	0.12	0.02672	0.04177	824.25	724.13
	1983	4	0.00104	0.01497	0.49334	896.23	0.12	0.02657	0.02672	862.03	824.25
	1984	4	0.00088	0.01996	0.47377	936.75	0.12	0.01497	0.02657	896.23	862.03
	1985	4	0.00087	0.01540	0.45528	983.83	0.11	0.01996	0.01497	936.75	896.23
	1986	4	0.00024	0.02047	0.43265	1020.28	0.1	0.01540	0.01996	983.83	936.75
	1987	4	0.00022	0.01963	0.45025	969.34	0.1	0.02047	0.01540	1020.28	983.83
	1988	4	0.00030	0.02890	0.50399	867.45	0.12	0.01963	0.02047	969.34	1020.28
	1989	4	0.00106	0.04834	0.53212	827.11	0.14	0.02890	0.01963	867.45	969.34
	1990	4	0.00025	0.05054	0.57230	754.66	0.12	0.04834	0.02890	827.11	867.45
	1991	4	0.00015	0.06105	0.60052	705.86	0.12	0.05054	0.04834	754.66	827.11
	1992	4	0.00059	0.08721	0.62630	665.51	0.14	0.06105	0.05054	705.86	754.66
	1993	4	0.00062	0.06853	0.66832	627.29	0.21	0.08721	0.06105	665.51	705.86
	1994	4	0.00063	0.09438	0.70639	596.07	0.22	0.06853	0.08721	627.29	665.51
	1995	4	0.00070	0.05542	0.69497	600.67	0.22	0.09438	0.06853	596.07	627.29
	1996	4	0.00075	0.04889	0.67845	615.87	0.2	0.05542	0.09438	600.67	596.07
	1997	4	0.00049	0.05660	0.66798	632.67	0.2	0.04889	0.05542	615.87	600.67
	1998	4	0.00046	0.05387	0.65461	650.1	0.2	0.05660	0.04889	632.67	615.87
	1999	4	0.00043	0.04494	0.63482	664.39	0.19	0.05387	0.05660	650.1	632.67
	2000	4	0.00046	0.03765	0.63206	678.16	0.21	0.04494	0.05387	664.39	650.1
CAR	1970	5	0.00043	0.02234	0.90978	343.71	0.07	0.03765	0.04494	678.16	664.39
	1971	5	0.00040	0.02390	0.91426	341.02	0.07	0.02234	0.03765	343.71	678.16
	1972	5	0.00032	0.03943	0.89585	334.8	0.06	0.02390	0.02234	341.02	343.71
	1973	5	0.00032	0.03864	0.96041	334.9	0.06	0.03943	0.02390	334.8	341.02
	1974	5	0.00019	0.05190	1.08041	349.34	0.05	0.03864	0.03943	334.9	334.8
	1975	5	0.00020	0.07737	1.06587	343.56	0.06	0.05190	0.03864	349.34	334.9
	1976	5	0.00023	0.05185	1.03528	354.28	0.08	0.07737	0.05190	343.56	349.34
	1977	5	0.00023	0.05795	1.02244	359.26	0.07	0.05185	0.07737	354.28	343.56
	1978	5	0.00027	0.06500	1.03132	354.76	0.08	0.05795	0.05185	359.26	354.28
	1979	5	0.00020	0.10904	1.08075	337.21	0.07	0.06500	0.05795	354.76	359.26
	1980	5	0.00022	0.15081	1.24263	313.57	0.07	0.10904	0.06500	337.21	354.76
	1981	5	0.00027	0.14077	1.30865	300.21	0.07	0.15081	0.10904	313.57	337.21
	1982	5	0.00026	0.11551	1.27142	314.16	0.06	0.14077	0.15081	300.21	313.57
	1983	5	0.00029	0.12981	1.41734	280.42	0.09	0.11551	0.14077	314.16	300.21
	1984	5	0.00027	0.16905	1.41884	298.61	0.08	0.12981	0.11551	280.42	314.16
	1985	5	0.00027	0.12828	1.40214	302.38	0.08	0.16905	0.12981	298.61	280.42
	1986	5	0.00027	0.16118	1.39557	305.81	0.08	0.12828	0.16905	302.38	298.61
	1987	5	0.00043	0.22584	1.37757	284.32	0.09	0.16118	0.12828	305.81	302.38
	1988	5	0.00038	0.25249	1.38149	283.02	0.08	0.22584	0.16118	284.32	305.81

	1989	5	0.00043	0.22830	1.16187	282.26	0.11	0.25249	0.22584	283.02	284.32
	1990	5	0.00035	0.30763	1.19328	269.71	0.1	0.22830	0.25249	282.26	283.02
	1991	5	0.00036	0.21559	1.15792	261.47	0.12	0.30763	0.22830	269.71	282.26
	1992	5	0.00040	0.23595	1.26886	238.27	0.12	0.21559	0.30763	261.47	269.71
	1993	5	0.00041	0.22734	1.34004	232.74	0.12	0.23595	0.21559	238.27	261.47
	1994	5	0.00040	0.21147	1.29997	237.86	0.1	0.22734	0.23595	232.74	238.27
	1995	5	0.00038	0.19752	1.23696	248.78	0.1	0.21147	0.22734	237.86	232.74
	1996	5	0.00041	0.20680	1.30552	233.37	0.11	0.19752	0.21147	248.78	237.86
	1997	5	0.00039	0.10606	1.30742	240.42	0.1	0.20680	0.19752	233.37	248.78
	1998	5	0.00038	0.13343	1.50635	246.65	0.09	0.10606	0.20680	240.42	233.37
	1999	5	0.00038	0.12684	1.58651	250.79	0.09	0.13343	0.10606	246.65	240.42
	2000	5	0.00038	0.07898	1.59877	251.08	0.09	0.12684	0.13343	250.79	246.65
Chad	1970	6	0.00018	0.02712	0.97379	219.42	0.11	0.07898	0.12684	251.08	250.79
	1971	6	0.00026	0.03774	1.00972	209.85	0.11	0.02712	0.07898	219.42	251.08
	1972	6	0.00020	0.03776	1.01450	207.65	0.11	0.03774	0.02712	209.85	219.42
	1973	6	0.00029	0.06065	1.13361	186.14	0.13	0.03776	0.03774	207.65	209.85
	1974	6	0.00028	0.10014	1.11666	191.24	0.13	0.06065	0.03776	186.14	207.65
	1975	6	0.00026	0.07812	1.04800	204.18	0.13	0.10014	0.06065	191.24	186.14
	1976	6	0.00026	0.06921	1.03407	206.05	0.11	0.07812	0.10014	204.18	191.24
	1977	6	0.00033	0.09070	1.03516	206.5	0.12	0.06921	0.07812	206.05	204.18
	1978	6	0.00027	0.13753	0.98094	201.49	0.1	0.09070	0.06921	206.5	206.05
	1979	6	0.00035	0.12050	0.92109	155.11	0.14	0.13753	0.09070	201.49	206.5
	1980	6	0.00047	0.05297	0.98956	142.71	0.15	0.12050	0.13753	155.11	201.49
	1981	6	0.00038	0.08922	0.98278	141.11	0.11	0.05297	0.12050	142.71	155.11
	1982	6	0.00037	0.09122	0.95694	145.37	0.11	0.08922	0.05297	141.11	142.71
	1983	6	0.00033	0.10745	0.89894	164.26	0.11	0.09122	0.08922	145.37	141.11
	1984	6	0.00033	0.12990	0.89817	163.51	0.13	0.10745	0.09122	164.26	145.37
	1985	6	0.00021	0.17701	0.75791	193.94	0.1	0.12990	0.10745	163.51	164.26
	1986	6	0.00022	0.16527	0.77065	180.86	0.12	0.17701	0.12990	193.94	163.51
	1987	6	0.00032	0.21308	0.82199	171.39	0.12	0.16527	0.17701	180.86	193.94
	1988	6	0.00007	0.23841	0.90416	191.98	0.09	0.21308	0.16527	171.39	180.86
	1989	6	0.00014	0.21846	0.91136	195.28	0.13	0.23841	0.21308	191.98	171.39
	1990	6	0.00015	0.28261	0.97080	181.52	0.14	0.21846	0.23841	195.28	191.98
	1991	6	0.00007	0.21991	0.98289	191.17	0.08	0.28261	0.21846	181.52	195.28
	1992	6	0.00007	0.18375	0.98039	200.38	0.08	0.21991	0.28261	191.17	181.52
	1993	6	0.00008	0.20582	1.19411	163.93	0.09	0.18375	0.21991	200.38	191.17
	1994	6	0.00008	0.17748	1.11214	175.23	0.11	0.20582	0.18375	163.93	200.38
	1995	6	0.00008	0.19409	1.12368	172.14	0.11	0.17748	0.20582	175.23	163.93
	1996	6	0.00008	0.23902	1.13043	170.74	0.11	0.19409	0.17748	172.14	175.23
	1997	6	0.00015	0.17411	1.12739	175.06	0.12	0.23902	0.19409	170.74	172.14
	1998	6	0.00007	0.11977	1.09213	181.6	0.1	0.17411	0.23902	175.06	170.74
	1999	6	0.00015	0.13523	1.15223	174.74	0.11	0.11977	0.17411	181.6	175.06
	2000	6	0.00016	0.09228	1.17121	171.66	0.11	0.13523	0.11977	174.74	181.6
DRC	1970	7	0.00054	0.01326	0.97112	327.96	0.13	0.09228	0.13523	171.66	174.74
	1971	7	0.00056	0.01503	0.94767	337.3	0.16	0.01326	0.09228	327.96	171.66
	1972	7	0.00058	0.01702	0.96803	327.82	0.16	0.01503	0.01326	337.3	327.96
	1973	7	0.00055	0.01797	0.92869	343.98	0.13	0.01702	0.01503	327.82	337.3
	1974	7	0.00059	0.02258	0.92293	344.1	0.14	0.01797	0.01702	343.98	327.82
	1975	7	0.00055	0.02691	0.99587	316.97	0.13	0.02258	0.01797	344.1	343.98

	1976	7	0.00065	0.02689	1.06881	290.79	0.15	0.02691	0.02258	316.97	344.1
	1977	7	0.00067	0.03591	1.09741	283.74	0.15	0.02689	0.02691	290.79	316.97
	1978	7	0.00068	0.04610	1.19446	260.1	0.16	0.03591	0.02689	283.74	290.79
	1979	7	0.00075	0.06044	1.23473	253.14	0.16	0.04610	0.03591	260.1	283.74
	1980	7	0.00065	0.06065	1.22272	250.94	0.15	0.06044	0.04610	253.14	260.1
	1981	7	0.00070	0.05454	1.25235	249.38	0.16	0.06065	0.06044	250.94	253.14
	1982	7	0.00056	0.04843	1.25797	241.19	0.15	0.05454	0.06065	249.38	250.94
	1983	7	0.00074	0.04274	1.32339	237.73	0.15	0.04843	0.05454	241.19	249.38
	1984	7	0.00067	0.03921	1.31579	243.83	0.1	0.04274	0.04843	237.73	241.19
	1985	7	0.00062	0.03967	1.31032	237.95	0.1	0.03921	0.04274	243.83	237.73
	1986	7	0.00056	0.05232	1.27515	241.98	0.09	0.03967	0.03921	237.95	243.83
	1987	7	0.00062	0.08141	1.29226	241.26	0.1	0.05232	0.03967	241.98	237.95
	1988	7	0.00063	0.06638	1.33386	235.16	0.11	0.08141	0.05232	241.26	241.98
	1989	7	0.00072	0.08894	1.38532	224.88	0.12	0.06638	0.08141	235.16	241.26
	1990	7	0.00073	0.11679	1.55190	203.1	0.12	0.08894	0.06638	224.88	235.16
	1991	7	0.00068	0.06769	1.72993	179.36	0.07	0.11679	0.08894	203.1	224.88
	1992	7	0.00070	0.04270	1.96687	154.56	0.07	0.06769	0.11679	179.36	203.1
	1993	7	0.00073	0.03268	2.31380	128.84	0.07	0.04270	0.06769	154.56	179.36
	1994	7	0.00068	0.04680	2.41718	119.66	0.06	0.03268	0.04270	128.84	154.56
	1995	7	0.00069	0.03701	2.50586	116.99	0.08	0.04680	0.03268	119.66	128.84
	1996	7	0.00072	0.03187	2.61052	112.97	0.09	0.03701	0.04680	116.99	119.66
	1997	7	0.00065	0.03209	2.81429	104.41	0.06	0.03187	0.03701	112.97	116.99
	1998	7	0.00067	0.02590	2.92925	100.78	0.06	0.03209	0.03187	104.41	112.97
	1999	7	0.00072	0.02858	3.12099	94.47	0.07	0.02590	0.03209	100.78	104.41
	2000	7	0.00042	0.03658	2.96766	96.77	0.05	0.02858	0.02590	94.47	100.78
Congo	1970	8	0.00079	0.01657	0.70655	702.65	0.07	0.03658	0.02858	96.77	94.47
	1971	8	0.00088	0.01714	0.67806	734.39	0.08	0.01657	0.03658	702.65	96.77
	1972	8	0.00079	0.02124	0.64448	773.46	0.06	0.01714	0.01657	734.39	702.65
	1973	8	0.00135	0.02261	0.61841	811.53	0.09	0.02124	0.01714	773.46	734.39
	1974	8	0.00169	0.02977	0.58514	848.72	0.1	0.02261	0.02124	811.53	773.46
	1975	8	0.00105	0.04087	0.55327	886.39	0.09	0.02977	0.02261	848.72	811.53
	1976	8	0.00115	0.05260	0.58807	867.25	0.1	0.04087	0.02977	886.39	848.72
	1977	8	0.00048	0.03829	0.63000	765.56	0.09	0.05260	0.04087	867.25	886.39
	1978	8	0.00029	0.06003	0.61327	789.43	0.09	0.03829	0.05260	765.56	867.25
	1979	8	0.00029	0.06139	0.56868	840.35	0.08	0.06003	0.03829	789.43	765.56
	1980	8	0.00028	0.05256	0.49905	958.06	0.05	0.06139	0.06003	840.35	789.43
	1981	8	0.00028	0.03959	0.43118	1091.86	0.06	0.05256	0.06139	958.06	840.35
	1982	8	0.00070	0.03662	0.36838	1307.36	0.06	0.03959	0.05256	1091.86	958.06
	1983	8	0.00056	0.04039	0.37885	1340.47	0.05	0.03662	0.03959	1307.36	1091.86
	1984	8	0.00053	0.03397	0.34501	1388.82	0.05	0.04039	0.03662	1340.47	1307.36
	1985	8	0.00059	0.02457	0.36374	1329.01	0.06	0.03397	0.04039	1388.82	1340.47
	1986	8	0.00053	0.04097	0.38480	1198.62	0.05	0.02457	0.03397	1329.01	1388.82
	1987	8	0.00066	0.05245	0.39170	1162.75	0.09	0.04097	0.02457	1198.62	1329.01
	1988	8	0.00073	0.03245	0.37778	1145.68	0.09	0.05245	0.04097	1162.75	1198.62
	1989	8	0.00046	0.03307	0.38245	1138.2	0.07	0.03245	0.05245	1145.68	1162.75
	1990	8	0.00057	0.07854	0.38192	1113.25	0.08	0.03307	0.03245	1138.2	1145.68
	1991	8	0.00047	0.04707	0.38215	1104.15	0.07	0.07854	0.03307	1113.25	1138.2
	1992	8	0.00058	0.03886	0.37694	1097.43	0.08	0.04707	0.07854	1104.15	1113.25
	1993	8	0.00060	0.04255	0.38353	1052.4	0.08	0.03886	0.04707	1097.43	1104.15

	1994	8	0.00105	0.13314	0.27597	963.04	0.1	0.04255	0.03886	1052.4	1097.43
	1995	8	0.00073	0.04375	0.27544	978.74	0.08	0.13314	0.04255	963.04	1052.4
	1996	8	0.00077	0.14423	0.26341	987.57	0.08	0.04375	0.13314	978.74	963.04
	1997	8	0.00107	0.09118	0.25013	949.38	0.09	0.14423	0.04375	987.57	978.74
	1998	8	0.00034	0.02142	0.24512	952.22	0.05	0.09118	0.14423	949.38	987.57
	1999	8	0.00038	0.04762	0.24195	893.82	0.07	0.02142	0.09118	952.22	949.38
	2000	8	0.00043	0.01021	0.26367	936.62	0.05	0.04762	0.02142	893.82	952.22
CoteD'vor	1970	9	0.00071	0.01137	0.51774	870.38	0.1	0.01021	0.04762	936.62	893.82
	1971	9	0.00070	0.01010	0.49418	913.01	0.1	0.01137	0.01021	870.38	936.62
	1972	9	0.00074	0.00915	0.50197	912.21	0.11	0.01010	0.01137	913.01	870.38
	1973	9	0.00074	0.01134	0.49137	925.98	0.1	0.00915	0.01010	912.21	913.01
	1974	9	0.00079	0.01298	0.49415	924.76	0.12	0.01134	0.00915	925.98	912.21
	1975	9	0.00082	0.01580	0.48042	957.06	0.12	0.01298	0.01134	924.76	925.98
	1976	9	0.00072	0.01509	0.45830	1032.05	0.09	0.01580	0.01298	957.06	924.76
	1977	9	0.00068	0.01360	0.43661	1056.95	0.08	0.01509	0.01580	1032.05	957.06
	1978	9	0.00074	0.01528	0.42032	1118.09	0.08	0.01360	0.01509	1056.95	1032.05
	1979	9	0.00080	0.01843	0.41494	1091.35	0.08	0.01528	0.01360	1118.09	1056.95
	1980	9	0.00105	0.02713	0.47369	926.54	0.13	0.01843	0.01528	1091.35	1118.09
	1981	9	0.00071	0.01538	0.45667	914.14	0.12	0.02713	0.01843	926.54	1091.35
	1982	9	0.00099	0.01701	0.45313	873.39	0.14	0.01538	0.02713	914.14	926.54
	1983	9	0.00076	0.02016	0.45958	801.05	0.14	0.01701	0.01538	873.39	914.14
	1984	9	0.00085	0.01640	0.48181	745.11	0.14	0.02016	0.01701	801.05	873.39
	1985	9	0.00121	0.01497	0.48416	745.93	0.15	0.01640	0.02016	745.11	801.05
	1986	9	0.00090	0.02156	0.51671	739.46	0.14	0.01497	0.01640	745.93	745.11
	1987	9	0.00116	0.02984	0.52932	708.82	0.19	0.02156	0.01497	739.46	745.93
	1988	9	0.00141	0.05210	0.53294	690.79	0.2	0.02984	0.02156	708.82	739.46
	1989	9	0.00126	0.04701	0.53472	686.27	0.19	0.05210	0.02984	690.79	708.82
	1990	9	0.00089	0.08269	0.53101	655.84	0.18	0.04701	0.05210	686.27	690.79
	1991	9	0.00085	0.07585	0.54668	634.8	0.18	0.08269	0.04701	655.84	686.27
	1992	9	0.00070	0.09121	0.59051	613.5	0.18	0.07585	0.08269	634.8	655.84
	1993	9	0.00091	0.09228	0.61137	593.93	0.19	0.09121	0.07585	613.5	634.8
	1994	9	0.00081	0.19111	0.62156	581.33	0.15	0.09228	0.09121	593.93	613.5
	1995	9	0.00105	0.13571	0.57909	605.17	0.16	0.19111	0.09228	581.33	593.93
	1996	9	0.00113	0.10023	0.60522	633.97	0.18	0.13571	0.19111	605.17	581.33
	1997	9	0.00106	0.04391	0.58812	652.27	0.21	0.10023	0.13571	633.97	605.17
	1998	9	0.00037	0.09078	0.56048	665.87	0.2	0.04391	0.10023	652.27	633.97
	1999	9	0.00088	0.04140	0.65615	660.67	0.2	0.09078	0.04391	665.87	652.27
	2000	9	0.00076	0.03367	0.65815	622.47	0.19	0.04140	0.09078	660.67	665.87
Ethiopia	1970	10	0.00052	0.01064	2.35311	128.77	0.03	0.03367	0.04140	622.47	660.67
	1971	10	0.00061	0.01181	2.26437	133.79	0.03	0.01064	0.03367	128.77	622.47
	1972	10	0.00041	0.01170	2.26982	132.46	0.03	0.01181	0.01064	133.79	128.77
	1973	10	0.00050	0.01577	2.23468	134.44	0.04	0.01170	0.01181	132.46	133.79
	1974	10	0.00050	0.02677	2.20210	135.97	0.04	0.01577	0.01170	134.44	132.46
	1975	10	0.00030	0.02979	2.21245	134.29	0.03	0.02677	0.01577	135.97	134.44
	1976	10	0.00030	0.03052	2.18880	135.33	0.03	0.02979	0.02677	134.29	135.97
	1977	10	0.00032	0.02593	2.31065	127.67	0.04	0.03052	0.02979	135.33	134.29
	1978	10	0.00042	0.03023	2.28717	129.02	0.05	0.02593	0.03052	127.67	135.33
	1979	10	0.00050	0.03825	2.18359	135.68	0.05	0.03023	0.02593	129.02	127.67
	1980	10	0.00050	0.04118	2.17288	135.99	0.06	0.03825	0.03023	135.68	129.02

	1981	10	0.00050	0.04640	2.16884	136.22	0.04	0.04118	0.03825	135.99	135.68
	1982	10	0.00041	0.03746	2.20415	133.48	0.04	0.04640	0.04118	136.22	135.99
	1983	10	0.00039	0.05889	2.09773	140.08	0.04	0.03746	0.04640	133.48	136.22
	1984	10	0.00041	0.06422	2.20501	132.82	0.06	0.05889	0.03746	140.08	133.48
	1985	10	0.00047	0.14472	2.55240	114.5	0.07	0.06422	0.05889	132.82	140.08
	1986	10	0.00056	0.11690	2.42815	120.87	0.05	0.14472	0.06422	114.5	132.82
	1987	10	0.00060	0.10063	2.20616	134.36	0.07	0.11690	0.14472	120.87	114.5
	1988	10	0.00062	0.15580	2.27376	130.04	0.07	0.10063	0.11690	134.36	120.87
	1989	10	0.00065	0.11904	2.38625	123.91	0.08	0.15580	0.10063	130.04	134.36
	1990	10	0.00067	0.16173	2.42787	121.93	0.08	0.11904	0.15580	123.91	130.04
	1991	10	0.00075	0.19082	2.72867	108.06	0.08	0.16173	0.11904	121.93	123.91
	1992	10	0.00073	0.22815	2.96129	93.01	0.07	0.19082	0.16173	108.06	121.93
	1993	10	0.00125	0.18729	2.56666	108.39	0.08	0.22815	0.19082	93.01	108.06
	1994	10	0.00062	0.17901	2.68636	108.15	0.05	0.18729	0.22815	108.39	93.01
	1995	10	0.00049	0.14001	2.63165	110.71	0.05	0.17901	0.18729	108.15	108.39
	1996	10	0.00067	0.11597	2.40733	120.81	0.05	0.14001	0.17901	110.71	108.15
	1997	10	0.00077	0.07924	2.36616	122.16	0.05	0.11597	0.14001	120.81	110.71
	1998	10	0.00095	0.09454	2.55143	114.03	0.05	0.07924	0.11597	122.16	120.81
	1999	10	0.00091	0.08635	2.44742	118.59	0.06	0.09454	0.07924	114.03	122.16
	2000	10	0.00100	0.08745	2.38612	122.01	0.06	0.08635	0.09454	118.59	114.03
Gabon	1970	11	0.00179	0.01518	0.67636	2956.32	0.07	0.08745	0.08635	122.01	118.59
	1971	11	0.00184	0.01375	0.62542	3193.66	0.08	0.01518	0.08745	2956.32	122.01
	1972	11	0.00180	0.01408	0.55028	3471.41	0.08	0.01375	0.01518	3193.66	2956.32
	1973	11	0.00335	0.01852	0.68748	3724.49	0.09	0.01408	0.01375	3471.41	3193.66
	1974	11	0.00256	0.00834	0.53622	5052.07	0.04	0.01852	0.01408	3724.49	3471.41
	1975	11	0.00187	0.01717	0.37230	5853.04	0.04	0.00834	0.01852	5052.07	3724.49
	1976	11	0.00175	0.00712	0.26466	7714.23	0.04	0.01717	0.00834	5853.04	5052.07
	1977	11	0.00222	0.00651	0.33247	6550.87	0.05	0.00712	0.01717	7714.23	5853.04
	1978	11	0.00318	0.01371	0.49393	4831.55	0.06	0.00651	0.00712	6550.87	7714.23
	1979	11	0.00290	0.01150	0.43568	4712.15	0.05	0.01371	0.00651	4831.55	6550.87
	1980	11	0.00256	0.01702	0.42790	4688.76	0.05	0.01150	0.01371	4712.15	4831.55
	1981	11	0.00254	0.01258	0.45641	4779.75	0.04	0.01702	0.01150	4688.76	4712.15
	1982	11	0.00264	0.01860	0.48603	4491.76	0.04	0.01258	0.01702	4779.75	4688.76
	1983	11	0.00209	0.01807	0.47190	4598.95	0.04	0.01860	0.01258	4491.76	4779.75
	1984	11	0.00233	0.01994	0.40927	4791.28	0.05	0.01807	0.01860	4598.95	4491.76
	1985	11	0.00263	0.01648	0.37619	4532.43	0.07	0.01994	0.01807	4791.28	4598.95
	1986	11	0.00218	0.02150	0.39182	4352.96	0.09	0.01648	0.01994	4532.43	4791.28
	1987	11	0.00252	0.02715	0.45739	3491.06	0.08	0.02150	0.01648	4352.96	4532.43
	1988	11	0.00273	0.03092	0.43779	3812.79	0.08	0.02715	0.02150	3491.06	4352.96
	1989	11	0.00383	0.03558	0.36156	4005.43	0.06	0.03092	0.02715	3812.79	3491.06
	1990	11	0.00207	0.03361	0.31836	4078.27	0.06	0.03558	0.03092	4005.43	3812.79
	1991	11	0.00094	0.03445	0.30726	4189.78	0.06	0.03361	0.03558	4078.27	4005.43
	1992	11	0.00094	0.01704	0.33806	3925.97	0.06	0.03445	0.03361	4189.78	4078.27
	1993	11	0.00126	0.02461	0.34652	3895.34	0.06	0.01704	0.03445	3925.97	4189.78
	1994	11	0.00109	0.04260	0.31308	3908.28	0.05	0.02461	0.01704	3895.34	3925.97
	1995	11	0.00111	0.03161	0.31253	4058.54	0.05	0.04260	0.02461	3908.28	3895.34
	1996	11	0.00102	0.02645	0.31457	4147.48	0.04	0.03161	0.04260	4058.54	3908.28
	1997	11	0.00099	0.00769	0.29983	4266.68	0.04	0.02645	0.03161	4147.48	4058.54
	1998	11	0.00042	0.00865	0.31352	4242.89	0.06	0.00769	0.02645	4266.68	4147.48

	1999	11	0.00040	0.00985	0.32430	3884.98	0.05	0.00865	0.00769	4242.89	4266.68
	2000	11	0.00040	0.00237	0.31266	3876.9	0.04	0.00985	0.00865	3884.98	4242.89
Gambia	1970	12	0.00048	0.00988	1.06683	282.36	0.03	0.00237	0.00985	3876.9	3884.98
	1971	12	0.00054	0.02668	1.09641	273.22	0.03	0.00988	0.00237	282.36	3876.9
	1972	12	0.00066	0.03678	1.12293	264.79	0.03	0.02668	0.00988	273.22	282.36
	1973	12	0.00058	0.04444	1.06978	279.47	0.03	0.03678	0.02668	264.79	273.22
	1974	12	0.00057	0.06642	1.05939	285.9	0.03	0.04444	0.03678	279.47	264.79
	1975	12	0.00078	0.04663	0.97654	310.72	0.04	0.06642	0.04444	285.9	279.47
	1976	12	0.00071	0.05861	0.92459	322.79	0.04	0.04663	0.06642	310.72	285.9
	1977	12	0.00079	0.11099	0.92700	323.27	0.05	0.05861	0.04663	322.79	310.72
	1978	12	0.00093	0.16789	0.93973	332.84	0.05	0.11099	0.05861	323.27	322.79
	1979	12	0.00098	0.17080	0.97362	318.04	0.05	0.16789	0.11099	332.84	323.27
	1980	12	0.00099	0.24660	0.95828	327.21	0.06	0.17080	0.16789	318.04	332.84
	1981	12	0.00095	0.30549	0.96024	327.24	0.05	0.24660	0.17080	327.21	318.04
	1982	12	0.00099	0.21068	0.92841	314.27	0.06	0.30549	0.24660	327.24	327.21
	1983	12	0.00088	0.16640	0.87665	337.02	0.05	0.21068	0.30549	314.27	327.24
	1984	12	0.00092	0.20595	0.87486	337.07	0.1	0.16640	0.21068	337.02	314.27
	1985	12	0.00092	0.19274	0.89271	322.5	0.08	0.20595	0.16640	337.07	337.02
	1986	12	0.00084	0.39087	0.89481	323.33	0.07	0.19274	0.20595	322.5	337.07
	1987	12	0.00093	0.38862	0.85294	318.72	0.07	0.39087	0.19274	323.33	322.5
	1988	12	0.00089	0.29969	0.87426	320.26	0.06	0.38862	0.39087	318.72	323.33
	1989	12	0.00083	0.33552	0.86455	326.33	0.05	0.29969	0.38862	320.26	318.72
	1990	12	0.00083	0.31937	0.89649	325.48	0.07	0.33552	0.29969	326.33	320.26
	1991	12	0.00084	0.31702	0.89690	323.58	0.07	0.31937	0.33552	325.48	326.33
	1992	12	0.00084	0.33533	0.89717	322.85	0.07	0.31702	0.31937	323.58	325.48
	1993	12	0.00084	0.25065	0.90296	321.2	0.07	0.33533	0.31702	322.85	323.58
	1994	12	0.00083	0.20570	0.92487	310.79	0.06	0.25065	0.33533	321.2	322.85
	1995	12	0.00085	0.13448	0.94203	302.94	0.06	0.20570	0.25065	310.79	321.2
	1996	12	0.00086	0.10443	0.95566	299.25	0.06	0.13448	0.20570	302.94	310.79
	1997	12	0.00080	0.10707	0.98161	303.46	0.06	0.10443	0.13448	299.25	302.94
	1998	12	0.00085	0.10307	0.98311	303.78	0.06	0.10707	0.10443	303.46	299.25
	1999	12	0.00086	0.08406	0.96273	312.89	0.06	0.10307	0.10707	303.78	303.46
	2000	12	0.00089	0.11636	0.94616	319.86	0.07	0.08406	0.10307	312.89	303.78
Ghana	1970	13	0.00138	0.02321	1.15649	283.54	0.11	0.11636	0.08406	319.86	312.89
	1971	13	0.00111	0.02120	1.13441	291.05	0.11	0.02321	0.11636	283.54	319.86
	1972	13	0.00122	0.02242	1.22612	276.09	0.11	0.02120	0.02321	291.05	283.54
	1973	13	0.00122	0.01521	1.26170	276.08	0.12	0.02242	0.02120	276.09	291.05
	1974	13	0.00136	0.01264	1.24484	287.21	0.13	0.01521	0.02242	276.08	276.09
	1975	13	0.00149	0.04938	1.47401	245.65	0.14	0.01264	0.01521	287.21	276.08
	1976	13	0.00134	0.02535	1.52832	232.34	0.13	0.04938	0.01264	245.65	287.21
	1977	13	0.00162	0.03635	1.58220	233.58	0.14	0.02535	0.04938	232.34	245.65
	1978	13	0.00146	0.04167	1.45340	249.12	0.09	0.03635	0.02535	233.58	232.34
	1979	13	0.00136	0.06410	1.50494	238.07	0.09	0.04167	0.03635	249.12	233.58
	1980	13	0.00127	0.07235	1.54076	233.32	0.08	0.06410	0.04167	238.07	249.12
	1981	13	0.00155	0.05663	1.66705	218.44	0.09	0.07235	0.06410	233.32	238.07
	1982	13	0.00165	0.05858	1.83957	196.47	0.09	0.05663	0.07235	218.44	233.32
	1983	13	0.00209	0.04795	1.63605	180.82	0.1	0.05858	0.05663	196.47	218.44
	1984	13	0.00135	0.08678	1.60438	189.55	0.06	0.04795	0.05858	180.82	196.47
	1985	13	0.00168	0.07528	1.69944	192.61	0.12	0.08678	0.04795	189.55	180.82

	1986	13	0.00151	0.13218	1.67587	196.4	0.11	0.07528	0.08678	192.61	189.55
	1987	13	0.00149	0.14375	1.73236	199.86	0.1	0.13218	0.07528	196.4	192.61
	1988	13	0.00145	0.14279	1.60674	205.26	0.1	0.14375	0.13218	199.86	196.4
	1989	13	0.00135	0.22656	1.64970	209.79	0.1	0.14279	0.14375	205.26	199.86
	1990	13	0.00154	0.17152	1.63542	210.82	0.1	0.22656	0.14279	209.79	205.26
	1991	13	0.00150	0.25573	1.60437	215.81	0.09	0.17152	0.22656	210.82	209.79
	1992	13	0.00149	0.17169	1.60158	218.01	0.09	0.25573	0.17152	215.81	210.82
	1993	13	0.00164	0.16615	1.59895	222.39	0.09	0.17169	0.25573	218.01	215.81
	1994	13	0.00175	0.14131	1.61140	223.7	0.09	0.16615	0.17169	222.39	218.01
	1995	13	0.00179	0.16111	1.62255	227.05	0.09	0.14131	0.16615	223.7	222.39
	1996	13	0.00181	0.15421	1.60504	231.82	0.09	0.16111	0.14131	227.05	223.7
	1997	13	0.00195	0.12110	1.61747	236.01	0.09	0.15421	0.16111	231.82	227.05
	1998	13	0.00185	0.15008	1.62564	241.61	0.09	0.12110	0.15421	236.01	231.82
	1999	13	0.00181	0.12710	1.61671	246.73	0.09	0.15008	0.12110	241.61	236.01
	2000	13	0.00167	0.12063	1.58645	250.27	0.09	0.12710	0.15008	246.73	241.61
Kenya	1970	14	0.00116	0.01749	2.23888	291.02	0.12	0.12063	0.12710	250.27	246.73
	1971	14	0.00122	0.01667	1.92089	343.18	0.13	0.01749	0.12063	291.02	250.27
	1972	14	0.00108	0.01532	1.69430	387.63	0.11	0.01667	0.01749	343.18	291.02
	1973	14	0.00102	0.01910	1.63699	395.83	0.11	0.01532	0.01667	387.63	343.18
	1974	14	0.00123	0.02254	1.60879	397.1	0.13	0.01910	0.01532	395.83	387.63
	1975	14	0.00126	0.02393	1.62982	386.11	0.13	0.02254	0.01910	397.1	395.83
	1976	14	0.00117	0.02902	1.65027	380.12	0.11	0.02393	0.02254	386.11	397.1
	1977	14	0.00118	0.02756	1.55485	400.94	0.11	0.02902	0.02393	380.12	386.11
	1978	14	0.00115	0.03937	1.48978	413	0.11	0.02756	0.02902	400.94	380.12
	1979	14	0.00101	0.05191	1.41907	428.09	0.11	0.03937	0.02756	413	400.94
	1980	14	0.00118	0.05551	1.38158	435.24	0.13	0.05191	0.03937	428.09	413
	1981	14	0.00121	0.06072	1.35567	434.78	0.13	0.05551	0.05191	435.24	428.09
	1982	14	0.00086	0.06450	1.34306	424.79	0.12	0.06072	0.05551	434.78	435.24
	1983	14	0.00085	0.05238	1.33644	414.28	0.12	0.06450	0.06072	424.79	434.78
	1984	14	0.00077	0.05237	1.36991	405.96	0.12	0.05238	0.06450	414.28	424.79
	1985	14	0.00063	0.05316	1.35340	407.98	0.12	0.05237	0.05238	405.96	414.28
	1986	14	0.00064	0.05150	1.34612	421.59	0.12	0.05316	0.05237	407.98	405.96
	1987	14	0.00075	0.06115	1.30436	430.9	0.12	0.05150	0.05316	421.59	407.98
	1988	14	0.00067	0.08597	1.24604	441.88	0.12	0.06115	0.05150	430.9	421.59
	1989	14	0.00070	0.10459	1.22015	447.06	0.12	0.08597	0.06115	441.88	430.9
	1990	14	0.00075	0.11190	1.18203	450.58	0.12	0.10459	0.08597	447.06	441.88
	1991	14	0.00061	0.08558	1.17050	442.53	0.11	0.11190	0.10459	450.58	447.06
	1992	14	0.00070	0.08312	1.20347	425.43	0.11	0.08558	0.11190	442.53	450.58
	1993	14	0.00078	0.08498	1.21677	414.22	0.1	0.08312	0.08558	425.43	442.53
	1994	14	0.00082	0.06171	1.13849	413.04	0.11	0.08498	0.08312	414.22	425.43
	1995	14	0.00087	0.06401	1.11914	419.6	0.1	0.06171	0.08498	413.04	414.22
	1996	14	0.00105	0.05021	1.08711	425.79	0.13	0.06401	0.06171	419.6	413.04
	1997	14	0.00094	0.03745	1.13550	417.35	0.12	0.05021	0.06401	425.79	419.6
	1998	14	0.00109	0.03359	1.16137	420.97	0.13	0.03745	0.05021	417.35	425.79
	1999	14	0.00109	0.02452	1.15936	420.82	0.12	0.03359	0.03745	420.97	417.35
	2000	14	0.00109	0.03948	1.16380	421.01	0.12	0.02452	0.03359	420.82	420.97
Liberia	1970	15	0.00166	0.01112	0.81047	836.55	0.04	0.03948	0.02452	421.01	420.82
	1971	15	0.00166	0.01047	0.80577	852.6	0.04	0.01112	0.03948	836.55	421.01
	1972	15	0.00161	0.01019	0.83591	862.53	0.04	0.01047	0.01112	852.6	836.55

	1973	15	0.00150	0.00830	0.82802	818.82	0.05	0.01019	0.01047	862.53	852.6
	1974	15	0.00166	0.01120	0.84171	832.83	0.06	0.00830	0.01019	818.82	862.53
	1975	15	0.00159	0.01598	0.87013	780.34	0.05	0.01120	0.00830	832.83	818.82
	1976	15	0.00149	0.02007	0.81841	797.89	0.06	0.01598	0.01120	780.34	832.83
	1977	15	0.00144	0.02435	0.81665	787.36	0.06	0.02007	0.01598	797.89	780.34
	1978	15	0.00143	0.03316	0.87106	801.32	0.06	0.02435	0.02007	787.36	797.89
	1979	15	0.00179	0.05542	0.86136	802.22	0.08	0.03316	0.02435	801.32	787.36
	1980	15	0.00198	0.06978	0.76161	744.48	0.07	0.05542	0.03316	802.22	801.32
	1981	15	0.00194	0.07948	0.77209	703.29	0.05	0.06978	0.05542	744.48	802.22
	1982	15	0.00061	0.08156	0.88570	661.62	0.05	0.07948	0.06978	703.29	744.48
	1983	15	0.00073	0.08999	0.79213	627.42	0.05	0.08156	0.07948	661.62	703.29
	1984	15	0.00075	0.10234	0.70420	597.84	0.05	0.08999	0.08156	627.42	661.62
	1985	15	0.00077	0.07156	0.74852	582.48	0.04	0.10234	0.08999	597.84	627.42
	1986	15	0.00079	0.07787	0.76941	567.97	0.04	0.07156	0.10234	582.48	597.84
	1987	15	0.00084	0.06344	0.88823	561.79	0.05	0.07787	0.07156	567.97	582.48
	1988	15	0.00090	0.05326	0.91652	553.18	0.06	0.06344	0.07787	561.79	567.97
	1989	15	0.00099	0.06798	1.06006	409.41	0.06	0.05326	0.06344	553.18	561.79
	1990	15	0.00147	0.26268	1.97810	202.72	0.08	0.06798	0.05326	409.41	553.18
	1991	15	0.00100	0.42440	2.14780	176.46	0.05	0.26268	0.06798	202.72	409.41
	1992	15	0.00151	0.49605	2.77206	116.52	0.06	0.42440	0.26268	176.46	202.72
	1993	15	0.00257	0.75700	2.82672	78.89	0.06	0.49605	0.42440	116.52	176.46
	1994	15	0.00331	0.50147	3.61347	61.16	0.06	0.75700	0.49605	78.89	116.52
	1995	15	0.00359	1.01699	3.82166	56.52	0.06	0.50147	0.75700	61.16	78.89
	1996	15	0.00341	1.27250	3.65013	59.45	0.05	1.01699	0.50147	56.52	61.16
	1997	15	0.00168	0.27149	2.63158	112.86	0.03	1.27250	1.01699	59.45	56.52
	1998	15	0.00141	0.19824	2.26393	134.28	0.05	0.27149	1.27250	112.86	59.45
	1999	15	0.00123	0.21051	2.46431	153.39	0.05	0.19824	0.27149	134.28	112.86
	2000	15	0.00103	0.12018	2.13685	182.98	0.09	0.21051	0.19824	153.39	134.28
Madaga	1970	16	0.00043	0.01709	1.37471	405.01	0.1	0.12018	0.21051	182.98	153.39
	1971	16	0.00043	0.01607	1.38514	410.06	0.1	0.01709	0.12018	405.01	182.98
	1972	16	0.00058	0.01899	1.27537	394.35	0.11	0.01607	0.01709	410.06	405.01
	1973	16	0.00051	0.01872	1.13301	374.03	0.11	0.01899	0.01607	394.35	410.06
	1974	16	0.00055	0.02194	1.14020	371.55	0.13	0.01872	0.01899	374.03	394.35
	1975	16	0.00077	0.02836	1.27035	366.31	0.13	0.02194	0.01872	371.55	374.03
	1976	16	0.00043	0.02184	1.25584	345.65	0.12	0.02836	0.02194	366.31	371.55
	1977	16	0.00039	0.02108	1.16636	344.38	0.11	0.02184	0.02836	345.65	366.31
	1978	16	0.00046	0.03234	1.36665	326.2	0.11	0.02108	0.02184	344.38	345.65
	1979	16	0.00047	0.04460	1.28345	348.63	0.11	0.03234	0.02108	326.2	344.38
	1980	16	0.00071	0.07408	1.28341	341.8	0.11	0.04460	0.03234	348.63	326.2
	1981	16	0.00050	0.08327	1.43904	300.11	0.09	0.07408	0.04460	341.8	348.63
	1982	16	0.00047	0.08738	1.39143	286.44	0.09	0.08327	0.07408	300.11	341.8
	1983	16	0.00029	0.06536	1.42871	280.91	0.08	0.08738	0.08327	286.44	300.11
	1984	16	0.00039	0.05326	1.51781	277.67	0.11	0.06536	0.08738	280.91	286.44
	1985	16	0.00050	0.06472	1.50903	273.01	0.11	0.05326	0.06536	277.67	280.91
	1986	16	0.00050	0.10655	1.47949	270.58	0.11	0.06472	0.05326	273.01	277.67
	1987	16	0.00061	0.11236	1.47046	266.12	0.11	0.10655	0.06472	270.58	273.01
	1988	16	0.00056	0.09728	1.48961	267.48	0.13	0.11236	0.10655	266.12	270.58
	1989	16	0.00040	0.10966	1.65128	270.56	0.11	0.09728	0.11236	267.48	266.12
	1990	16	0.00040	0.12157	1.66481	271.13	0.11	0.10966	0.09728	270.56	267.48

	1991	16	0.00044	0.14876	1.62035	246.78	0.12	0.12157	0.10966	271.13	270.56
	1992	16	0.00045	0.11680	1.63898	242.56	0.12	0.14876	0.12157	246.78	271.13
	1993	16	0.00043	0.11430	1.62299	240.5	0.11	0.11680	0.14876	242.56	246.78
	1994	16	0.00042	0.09124	1.48247	233.34	0.11	0.11430	0.11680	240.5	242.56
	1995	16	0.00033	0.09320	1.50523	230.37	0.1	0.09124	0.11430	233.34	240.5
	1996	16	0.00053	0.10808	1.47972	228.34	0.11	0.09320	0.09124	230.37	233.34
	1997	16	0.00065	0.24481	1.48766	229.73	0.12	0.10808	0.09320	228.34	230.37
	1998	16	0.00064	0.13601	1.67143	231.67	0.12	0.24481	0.10808	229.73	228.34
	1999	16	0.00069	0.09688	1.67745	235.34	0.12	0.13601	0.24481	231.67	229.73
	2000	16	0.00079	0.08295	1.81398	239.43	0.12	0.09688	0.13601	235.34	231.67
Malawi	1970	17	0.00100	0.06694	4.44079	121.6	0.14	0.08295	0.09688	239.43	235.34
	1971	17	0.00098	0.04934	3.93712	137.41	0.14	0.06694	0.08295	121.6	239.43
	1972	17	0.00095	0.05331	3.73034	141.81	0.09	0.04934	0.06694	137.41	121.6
	1973	17	0.00106	0.04268	3.65031	140.81	0.13	0.05331	0.04934	141.81	137.41
	1974	17	0.00092	0.05568	3.39574	146.36	0.12	0.04268	0.05331	140.81	141.81
	1975	17	0.00099	0.07969	3.31007	150.45	0.13	0.05568	0.04268	146.36	140.81
	1976	17	0.00097	0.07445	3.27751	152.86	0.12	0.07969	0.05568	150.45	146.36
	1977	17	0.00096	0.09077	2.94175	155.01	0.12	0.07445	0.07969	152.86	150.45
	1978	17	0.00090	0.10297	2.71881	164.41	0.11	0.09077	0.07445	155.01	152.86
	1979	17	0.00189	0.14202	2.63095	166.1	0.16	0.10297	0.09077	164.41	155.01
	1980	17	0.00092	0.14737	2.64688	161.7	0.14	0.14202	0.10297	166.1	164.41
	1981	17	0.00082	0.14432	2.81265	148.97	0.14	0.14737	0.14202	161.7	166.1
	1982	17	0.00082	0.12387	2.76770	148.86	0.14	0.14432	0.14737	148.97	161.7
	1983	17	0.00081	0.11470	2.70270	150.22	0.14	0.12387	0.14432	148.86	148.97
	1984	17	0.00071	0.17097	2.62280	152.89	0.14	0.11470	0.12387	150.22	148.86
	1985	17	0.00071	0.10139	2.58857	152.98	0.14	0.17097	0.11470	152.89	150.22
	1986	17	0.00085	0.17573	2.71205	144.54	0.15	0.10139	0.17097	152.98	152.89
	1987	17	0.00088	0.24486	2.79386	138.16	0.17	0.17573	0.10139	144.54	152.98
	1988	17	0.00060	0.32365	2.84671	134.19	0.16	0.24486	0.17573	138.16	144.54
	1989	17	0.00063	0.35485	2.92615	129.18	0.18	0.32365	0.24486	134.19	138.16
	1990	17	0.00064	0.40256	2.84605	131.41	0.19	0.35485	0.32365	129.18	134.19
	1991	17	0.00062	0.40661	2.64573	139.47	0.18	0.40256	0.35485	131.41	129.18
	1992	17	0.00074	0.46076	2.82242	127.55	0.21	0.40661	0.40256	139.47	131.41
	1993	17	0.00068	0.36127	2.57019	138.9	0.16	0.46076	0.40661	127.55	139.47
	1994	17	0.00076	0.38126	2.84629	123.67	0.17	0.36127	0.46076	138.9	127.55
	1995	17	0.00066	0.30161	2.51458	142.37	0.16	0.38126	0.36127	123.67	138.9
	1996	17	0.00063	0.31821	2.35884	149.65	0.14	0.30161	0.38126	142.37	123.67
	1997	17	0.00062	0.21448	2.29870	151.39	0.14	0.31821	0.30161	149.65	142.37
	1998	17	0.00062	0.26089	2.35510	152.86	0.14	0.21448	0.31821	151.39	149.65
	1999	17	0.00062	0.26030	2.45607	153.09	0.13	0.26089	0.21448	152.86	151.39
	2000	17	0.00062	0.25593	2.55530	151.45	0.13	0.26030	0.26089	153.09	152.86
Mali	1970	18	0.00028	0.02128	1.48512	191.23	0.08	0.25593	0.26030	151.45	153.09
	1971	18	0.00028	0.02802	1.49254	190.95	0.08	0.02128	0.25593	191.23	151.45
	1972	18	0.00029	0.03351	1.45451	196.63	0.09	0.02802	0.02128	190.95	191.23
	1973	18	0.00026	0.06355	1.57021	188.51	0.08	0.03351	0.02802	196.63	190.95
	1974	18	0.00037	0.10591	1.65449	180.72	0.09	0.06355	0.03351	188.51	196.63
	1975	18	0.00034	0.11432	1.52563	196.64	0.07	0.10591	0.06355	180.72	188.51
	1976	18	0.00031	0.06195	1.38488	218.07	0.06	0.11432	0.10591	196.64	180.72
	1977	18	0.00036	0.07467	1.34593	226.61	0.06	0.06195	0.11432	218.07	196.64

	1978	18	0.00037	0.10802	1.37884	218.3	0.08	0.07467	0.06195	226.61	218.07
	1979	18	0.00034	0.11681	1.31585	235.59	0.05	0.10802	0.07467	218.3	226.61
	1980	18	0.00037	0.17083	1.46217	220.22	0.07	0.11681	0.10802	235.59	218.3
	1981	18	0.00039	0.15530	1.48876	205.54	0.07	0.17083	0.11681	220.22	235.59
	1982	18	0.00035	0.14915	1.60489	191.29	0.06	0.15530	0.17083	205.54	220.22
	1983	18	0.00041	0.14495	1.50826	195.59	0.07	0.14915	0.15530	191.29	205.54
	1984	18	0.00041	0.20729	1.50610	199.19	0.07	0.14495	0.14915	195.59	191.29
	1985	18	0.00039	0.27563	1.66541	172.33	0.07	0.20729	0.14495	199.19	195.59
	1986	18	0.00037	0.24789	1.60070	182.42	0.07	0.27563	0.20729	172.33	199.19
	1987	18	0.00040	0.24414	1.68181	177.19	0.09	0.24789	0.27563	182.42	172.33
	1988	18	0.00038	0.29160	1.61777	175.55	0.09	0.24414	0.24789	177.19	182.42
	1989	18	0.00035	0.26892	1.46237	191.47	0.09	0.29160	0.24414	175.55	177.19
	1990	18	0.00037	0.29385	1.53309	183.29	0.09	0.26892	0.29160	191.47	175.55
	1991	18	0.00037	0.27144	1.49821	181.55	0.09	0.29385	0.26892	183.29	191.47
	1992	18	0.00035	0.23934	1.46652	191.61	0.07	0.27144	0.29385	181.55	183.29
	1993	18	0.00037	0.20542	1.49507	182.6	0.08	0.23934	0.27144	191.61	181.55
	1994	18	0.00038	0.24810	1.12040	179.4	0.08	0.20542	0.23934	182.6	191.61
	1995	18	0.00036	0.28675	1.12135	185.49	0.08	0.24810	0.20542	179.4	182.6
	1996	18	0.00036	0.25201	1.12137	186.38	0.08	0.28675	0.24810	185.49	179.4
	1997	18	0.00035	0.20680	1.11530	193.67	0.04	0.25201	0.28675	186.38	185.49
	1998	18	0.00034	0.15795	1.10105	199.81	0.04	0.20680	0.25201	193.67	186.38
	1999	18	0.00033	0.15102	1.08973	207.39	0.04	0.15795	0.20680	199.81	193.67
	2000	18	0.00032	0.14828	1.10101	207.99	0.04	0.15102	0.15795	207.39	199.81
Mauritani	1970	19	0.00099	0.01278	1.07011	465.69	0.14	0.14828	0.15102	207.99	207.39
	1971	19	0.00090	0.02440	1.06312	463.1	0.13	0.01278	0.14828	465.69	207.99
	1972	19	0.00102	0.02246	0.97554	448.86	0.13	0.02440	0.01278	463.1	465.69
	1973	19	0.00113	0.05446	1.01349	418.14	0.14	0.02246	0.02440	448.86	463.1
	1974	19	0.00103	0.14900	0.92530	457.84	0.14	0.05446	0.02246	418.14	448.86
	1975	19	0.00112	0.11106	1.09773	423.91	0.15	0.14900	0.05446	457.84	418.14
	1976	19	0.00105	0.29847	0.96671	449.03	0.13	0.11106	0.14900	423.91	457.84
	1977	19	0.00113	0.26361	0.93431	429.91	0.14	0.29847	0.11106	449.03	423.91
	1978	19	0.00120	0.36727	1.06817	417.35	0.13	0.26361	0.29847	429.91	449.03
	1979	19	0.00120	0.24776	0.79667	426.75	0.13	0.36727	0.26361	417.35	429.91
	1980	19	0.00119	0.25321	0.93347	430.51	0.12	0.24776	0.36727	426.75	417.35
	1981	19	0.00121	0.29747	0.91994	434.67	0.13	0.25321	0.24776	430.51	426.75
	1982	19	0.00160	0.26702	0.96189	414.35	0.13	0.29747	0.25321	434.67	430.51
	1983	19	0.00171	0.24166	0.92329	419.64	0.14	0.26702	0.29747	414.35	434.67
	1984	19	0.00164	0.24537	0.85641	396.62	0.14	0.24166	0.26702	419.64	414.35
	1985	19	0.00119	0.28341	1.03217	399.14	0.13	0.24537	0.24166	396.62	419.64
	1986	19	0.00082	0.29923	0.96499	412.46	0.12	0.28341	0.24537	399.14	396.62
	1987	19	0.00562	0.24690	0.72837	410.97	0.13	0.29923	0.28341	412.46	399.14
	1988	19	0.00545	0.22956	0.97471	408.78	0.13	0.24690	0.29923	410.97	412.46
	1989	19	0.00458	0.30175	0.80673	418.69	0.12	0.22956	0.24690	408.78	410.97
	1990	19	0.00437	0.28936	0.96912	401.85	0.1	0.30175	0.22956	418.69	408.78
	1991	19	0.00443	0.26168	0.91996	399.42	0.11	0.28936	0.30175	401.85	418.69
	1992	19	0.00459	0.23594	0.84298	397.14	0.08	0.26168	0.28936	399.42	401.85
	1993	19	0.00438	0.36238	0.92522	410.12	0.1	0.23594	0.26168	397.14	399.42
	1994	19	0.00644	0.41431	1.16620	287.54	0.09	0.36238	0.23594	410.12	397.14
	1995	19	0.00417	0.24100	0.77692	414.6	0.08	0.41431	0.36238	287.54	410.12

	1996	19	0.00392	0.26922	0.93201	427.13	0.09	0.24100	0.41431	414.6	287.54
	1997	19	0.00410	0.24555	0.77674	398.82	0.09	0.26922	0.24100	427.13	414.6
	1998	19	0.00332	0.16527	0.86714	398.62	0.09	0.24555	0.26922	398.82	427.13
	1999	19	0.00314	0.20585	0.88646	413.26	0.11	0.16527	0.24555	398.62	398.82
	2000	19	0.00311	0.19553	0.97571	408.83	0.09	0.20585	0.16527	413.26	398.62
Moza	1970	20	0.00246	0.00006	5.04882	170.43	0.12	0.19553	0.20585	408.83	413.26
	1971	20	0.00275	0.00006	4.73964	181.67	0.12	0.00006	0.19553	170.43	408.83
	1972	20	0.00238	0.00005	4.53820	182.07	0.12	0.00006	0.00006	181.67	170.43
	1973	20	0.00258	0.00006	4.54536	178.34	0.12	0.00005	0.00006	182.07	181.67
	1974	20	0.00229	0.00040	4.43048	176.85	0.12	0.00006	0.00005	178.34	182.07
	1975	20	0.00203	0.01067	4.21259	179.97	0.11	0.00040	0.00006	176.85	178.34
	1976	20	0.00171	0.03552	4.02223	181.32	0.09	0.01067	0.00040	179.97	176.85
	1977	20	0.00173	0.03827	3.85057	187.11	0.09	0.03552	0.01067	181.32	179.97
	1978	20	0.00182	0.04888	3.68954	185.98	0.1	0.03827	0.03552	187.11	181.32
	1979	20	0.00160	0.06580	3.60979	186.03	0.06	0.04888	0.03827	185.98	187.11
	1980	20	0.00189	0.07443	3.59619	186.35	0.07	0.06580	0.04888	186.03	185.98
	1981	20	0.00141	0.05950	3.35326	191.08	0.05	0.07443	0.06580	186.35	186.03
	1982	20	0.00155	0.09317	3.60082	173.88	0.05	0.05950	0.07443	191.08	186.35
	1983	20	0.00141	0.11188	4.23219	143.63	0.04	0.09317	0.05950	173.88	191.08
	1984	20	0.00123	0.14705	4.47330	132.2	0.04	0.11188	0.09317	143.63	173.88
	1985	20	0.00092	0.16924	4.41270	132.18	0.04	0.14705	0.11188	132.2	143.63
	1986	20	0.00074	0.24604	4.47521	128.68	0.05	0.16924	0.14705	132.18	132.2
	1987	20	0.00064	0.33974	3.86121	147.85	0.05	0.24604	0.16924	128.68	132.18
	1988	20	0.00067	0.43268	3.52610	160.35	0.09	0.33974	0.24604	147.85	128.68
	1989	20	0.00064	0.35677	3.27494	170.22	0.09	0.43268	0.33974	160.35	147.85
	1990	20	0.00056	0.43777	3.16101	169.68	0.1	0.35677	0.43268	170.22	160.35
	1991	20	0.00054	0.44560	2.99465	173.72	0.11	0.43777	0.35677	169.68	170.22
	1992	20	0.00062	0.66812	3.31372	153.61	0.12	0.44560	0.43777	173.72	169.68
	1993	20	0.00060	0.50377	3.16225	157.97	0.09	0.66812	0.44560	153.61	173.72
	1994	20	0.00058	0.48023	2.75676	162.84	0.08	0.50377	0.66812	157.97	153.61
	1995	20	0.00058	0.41191	2.63622	162.68	0.09	0.48023	0.50377	162.84	157.97
	1996	20	0.00048	0.32156	2.45897	168.77	0.09	0.41191	0.48023	162.68	162.84
	1997	20	0.00052	0.30989	2.23900	182.68	0.1	0.32156	0.41191	168.77	162.68
	1998	20	0.00047	0.30186	1.99070	201.02	0.09	0.30989	0.32156	182.68	168.77
	1999	20	0.00050	0.21718	1.89491	211.44	0.13	0.30186	0.30989	201.02	182.68
	2000	20	0.00044	0.22769	1.86812	214.81	0.13	0.21718	0.30186	211.44	201.02
Nigeria	1970	21	0.00004	0.00526	1.77754	382	0.03	0.22769	0.21718	214.81	211.44
	1971	21	0.00321	0.00466	1.60000	425	0.04	0.00526	0.22769	382	214.81
	1972	21	0.00321	0.00459	1.60140	429	0.04	0.00466	0.00526	425	382
	1973	21	0.00328	0.00304	1.58503	441	0.04	0.00459	0.00466	429	425
	1974	21	0.00297	0.00233	1.46960	477	0.03	0.00304	0.00459	441	429
	1975	21	0.00319	0.00275	1.61818	440	0.05	0.00233	0.00304	477	441
	1976	21	0.00293	0.00221	1.56009	466	0.05	0.00275	0.00233	440	477
	1977	21	0.00284	0.00210	1.54375	480	0.05	0.00221	0.00275	466	440
	1978	21	0.00333	0.00221	1.71690	438	0.07	0.00210	0.00221	480	466
	1979	21	0.00324	0.00035	1.67181	454	0.09	0.00221	0.00210	438	480
	1980	21	0.00300	0.00172	1.67826	460	0.08	0.00035	0.00221	454	438
	1981	21	0.00272	0.00224	2.02577	388	0.08	0.00172	0.00035	460	454
	1982	21	0.00398	0.00114	2.12732	377	0.1	0.00224	0.00172	388	460

	1983	21	0.00396	0.00187	2.30747	348	0.1	0.00114	0.00224	377	388
	1984	21	0.00516	0.00124	2.43789	322	0.11	0.00187	0.00114	348	377
	1985	21	0.00377	0.00023	2.29361	344	0.09	0.00124	0.00187	322	348
	1986	21	0.00443	0.00178	2.26316	342	0.09	0.00023	0.00124	344	322
	1987	21	0.00414	0.00282	2.36970	330	0.07	0.00178	0.00023	342	344
	1988	21	0.00425	0.00388	2.22380	353	0.08	0.00282	0.00178	330	342
	1989	21	0.00004	0.01087	2.14986	367	0.05	0.00388	0.00282	353	330
	1990	21	0.00354	0.00883	2.02850	386	0.06	0.01087	0.00388	367	353
	1991	21	0.00003	0.00832	2.02799	393	0.04	0.00883	0.01087	386	367
	1992	21	0.00271	0.00810	2.05838	394	0.04	0.00832	0.00883	393	386
	1993	21	0.00349	0.00737	2.05371	391	0.04	0.00810	0.00832	394	393
	1994	21	0.00004	0.00606	1.99738	381	0.05	0.00737	0.00810	391	394
	1995	21	0.00014	0.00535	2.03150	381	0.05	0.00606	0.00737	381	391
	1996	21	0.00003	0.00519	2.01809	387	0.05	0.00535	0.00606	381	381
	1997	21	0.00000	0.00517	2.01809	387	0.05	0.00519	0.00535	387	381
	1998	21	0.00004	0.00509	1.96623	385	0.05	0.00517	0.00519	387	387
	1999	21	0.00004	0.00389	1.97895	380	0.05	0.00509	0.00517	385	387
	2000	21	0.00003	0.00269	1.94118	391	0.04	0.00389	0.00509	380	385
Senegal	1970	22	0.00006	0.02016	0.63677	446	0.13	0.00269	0.00389	391	380
	1971	22	0.00003	0.02547	0.65820	433	0.12	0.02016	0.00269	446	391
	1972	22	0.00003	0.02208	0.63839	448	0.12	0.02547	0.02016	433	446
	1973	22	0.00007	0.03832	0.72019	411	0.12	0.02208	0.02547	448	433
	1974	22	0.00013	0.06546	0.71875	416	0.12	0.03832	0.02208	411	448
	1975	22	0.00006	0.05885	0.68807	436	0.13	0.06546	0.03832	416	411
	1976	22	0.00003	0.04739	0.65227	463	0.1	0.05885	0.06546	436	416
	1977	22	0.00009	0.05089	0.69318	440	0.11	0.04739	0.05885	463	436
	1978	22	0.00016	0.09194	0.73058	412	0.13	0.05089	0.04739	440	463
	1979	22	0.00006	0.12100	0.72093	430	0.1	0.09194	0.05089	412	440
	1980	22	0.00316	0.10847	0.79310	406	0.11	0.12100	0.09194	430	412
	1981	22	0.00360	0.16351	0.78462	390	0.12	0.10847	0.12100	406	430
	1982	22	0.00019	0.10274	0.70091	438	0.1	0.16351	0.10847	390	406
	1983	22	0.00003	0.11196	0.67972	434	0.09	0.10274	0.16351	438	390
	1984	22	0.00007	0.13435	0.74074	405	0.13	0.11196	0.10274	434	438
	1985	22	0.00003	0.09998	0.70343	408	0.12	0.13435	0.11196	405	434
	1986	22	0.00010	0.19568	0.70531	414	0.13	0.09998	0.13435	408	405
	1987	22	0.00006	0.21768	0.71292	418	0.13	0.19568	0.09998	414	408
	1988	22	0.00010	0.18646	0.66667	426	0.13	0.21768	0.19568	418	414
	1989	22	0.00003	0.22331	0.68627	408	0.13	0.18646	0.21768	426	418
	1990	22	0.00007	0.24740	0.68370	411	0.13	0.22331	0.18646	408	426
	1991	22	0.00003	0.19093	0.68342	398	0.13	0.24740	0.22331	411	408
	1992	22	0.00014	0.19955	0.70960	396	0.13	0.19093	0.24740	398	411
	1993	22	0.00014	0.15127	0.72414	377	0.14	0.19955	0.19093	396	398
	1994	22	0.00004	0.19024	0.53175	378	0.13	0.15127	0.19955	377	396
	1995	22	0.00007	0.18558	0.53747	387	0.13	0.19024	0.15127	378	377
	1996	22	0.00003	0.15453	0.52645	397	0.13	0.18558	0.19024	387	378
	1997	22	0.00003	0.10903	0.54000	400	0.13	0.15453	0.18558	397	387
	1998	22	0.00003	0.12575	0.54054	407	0.13	0.10903	0.15453	400	397
	1999	22	0.00006	0.12517	0.53555	422	0.13	0.12575	0.10903	407	400
	2000	22	0.00009	0.09595	0.53630	427	0.13	0.12517	0.12575	422	407

SA	1970	23	0.00299	0.00000	0.64143	3104	0.23	0.09595	0.12517	427	422
	1971	23	0.00294	0.00000	0.63389	3163	0.22	0.00000	0.09595	3104	427
	1972	23	0.00301	0.00000	0.63538	3143	0.23	0.00000	0.00000	3163	3104
	1973	23	0.00298	0.00000	0.64550	3213	0.22	0.00000	0.00000	3143	3163
	1974	23	0.00292	0.00000	0.63437	3334	0.21	0.00000	0.00000	3213	3143
	1975	23	0.00289	0.00000	0.65862	3316	0.21	0.00000	0.00000	3334	3213
	1976	23	0.00331	0.00000	0.66647	3319	0.23	0.00000	0.00000	3316	3334
	1977	23	0.00306	0.00000	0.67622	3246	0.21	0.00000	0.00000	3319	3316
	1978	23	0.00298	0.00000	0.69374	3275	0.21	0.00000	0.00000	3246	3319
	1979	23	0.00330	0.00000	0.69113	3325	0.22	0.00000	0.00000	3275	3246
	1980	23	0.00325	0.00000	0.68496	3463	0.22	0.00000	0.00000	3325	3275
	1981	23	0.00343	0.00000	0.71637	3561	0.24	0.00000	0.00000	3463	3325
	1982	23	0.00334	0.00000	0.78324	3460	0.24	0.00000	0.00000	3561	3463
	1983	23	0.00381	0.00000	0.81118	3310	0.23	0.00000	0.00000	3460	3561
	1984	23	0.00363	0.00000	0.83746	3390	0.21	0.00000	0.00000	3310	3460
	1985	23	0.00364	0.00000	0.84922	3263	0.22	0.00000	0.00000	3390	3310
	1986	23	0.00391	0.00000	0.88620	3181	0.22	0.00000	0.00000	3263	3390
	1987	23	0.00385	0.00000	0.89517	3167	0.22	0.00000	0.00000	3181	3263
	1988	23	0.00379	0.00000	0.89668	3223	0.23	0.00000	0.00000	3167	3181
	1989	23	0.00375	0.00000	0.83731	3227	0.23	0.00000	0.00000	3223	3167
	1990	23	0.00352	0.00000	0.82234	3152	0.24	0.00000	0.00000	3227	3223
	1991	23	0.00368	0.00000	0.86878	3056	0.23	0.00000	0.00000	3152	3227
	1992	23	0.00368	0.00000	0.83237	2929	0.22	0.00000	0.00000	3056	3152
	1993	23	0.00378	0.00252	0.87048	2903	0.21	0.00000	0.00000	2929	3056
	1994	23	0.00379	0.00271	0.88821	2934	0.21	0.00252	0.00000	2903	2929
	1995	23	0.00381	0.00339	0.89899	2960	0.21	0.00271	0.00252	2934	2903
	1996	23	0.00372	0.00307	0.87583	3020	0.2	0.00339	0.00271	2960	2934
	1997	23	0.00369	0.00391	0.87228	3030	0.2	0.00307	0.00339	3020	2960
	1998	23	0.00377	0.00404	0.87798	2975	0.19	0.00391	0.00307	3030	3020
	1999	23	0.00379	0.00445	0.85767	2972	0.19	0.00404	0.00391	2975	3030
	2000	23	0.00333	0.00376	0.84967	3020	0.19	0.00445	0.00404	2972	2975
Sudan	1970	24	0.00010	0.00292	1.71910	267	0.08	0.00376	0.00445	3020	2972
	1971	24	0.00005	0.00396	1.73585	265	0.07	0.00292	0.00376	267	3020
	1972	24	0.00006	0.01216	1.86123	245	0.07	0.00396	0.00292	265	267
	1973	24	0.00006	0.00887	1.92887	239	0.07	0.01216	0.00396	245	265
	1974	24	0.00005	0.03911	1.76744	258	0.07	0.00887	0.01216	239	245
	1975	24	0.00005	0.05066	1.49310	290	0.07	0.03911	0.00887	258	239
	1976	24	0.00004	0.04049	1.31098	328	0.06	0.05066	0.03911	290	258
	1977	24	0.00004	0.04760	1.27893	337	0.06	0.04049	0.05066	328	290
	1978	24	0.00004	0.06146	1.36364	308	0.06	0.04760	0.04049	337	328
	1979	24	0.00005	0.12325	1.47703	283	0.07	0.06146	0.04760	308	337
	1980	24	0.00005	0.11194	1.51439	278	0.07	0.12325	0.06146	283	308
	1981	24	0.00005	0.10301	1.43945	289	0.07	0.11194	0.12325	278	283
	1982	24	0.00005	0.11601	1.39527	296	0.07	0.10301	0.11194	289	278
	1983	24	0.00000	0.14696	1.41638	293	0.08	0.11601	0.10301	296	289
	1984	24	0.00005	0.09956	1.48519	270	0.08	0.14696	0.11601	293	296
	1985	24	0.00005	0.19508	1.65447	246	0.09	0.09956	0.14696	270	293
	1986	24	0.00005	0.15601	1.59289	253	0.09	0.19508	0.09956	246	270
	1987	24	0.00005	0.12883	1.37589	282	0.09	0.15601	0.19508	253	246

	1988	24	0.00005	0.13384	1.46377	276	0.08	0.12883	0.15601	282	253
	1989	24	0.00005	0.09901	1.34694	294	0.07	0.13384	0.12883	276	282
	1990	24	0.00005	0.11456	1.50000	272	0.08	0.09901	0.13384	294	276
	1991	24	0.00005	0.11395	1.38811	286	0.08	0.11456	0.09901	272	294
	1992	24	0.00005	0.06648	1.30537	298	0.08	0.11395	0.11456	286	272
	1993	24	0.00004	0.05270	1.21382	304	0.07	0.06648	0.11395	298	286
	1994	24	0.00005	0.04740	1.39000	300	0.08	0.05270	0.06648	304	298
	1995	24	0.00004	0.02558	1.31613	310	0.09	0.04740	0.05270	300	304
	1996	24	0.00004	0.02296	1.43302	321	0.09	0.02558	0.04740	310	300
	1997	24	0.00004	0.01246	1.42342	333	0.09	0.02296	0.02558	321	310
	1998	24	0.00004	0.01948	1.35159	347	0.09	0.01246	0.02296	333	321
	1999	24	0.00004	0.02164	1.15833	360	0.09	0.01948	0.01246	347	333
	2000	24	0.00004	0.01875	1.11436	376	0.08	0.02164	0.01948	360	347
Tanzania	1970	25	0.00000	0.02052	2.55924	211	0.04	0.01875	0.02164	376	360
	1971	25	0.00006	0.01855	2.31197	234	0.04	0.02052	0.01875	211	376
	1972	25	0.00006	0.01906	2.27039	233	0.04	0.01855	0.02052	234	211
	1973	25	0.00006	0.02906	2.09796	245	0.08	0.01906	0.01855	233	234
	1974	25	0.00005	0.04231	2.01215	247	0.08	0.02906	0.01906	245	233
	1975	25	0.00005	0.07060	1.91270	252	0.08	0.04231	0.02906	247	245
	1976	25	0.00005	0.06470	1.88048	251	0.09	0.07060	0.04231	252	247
	1977	25	0.00005	0.07830	1.80237	253	0.09	0.06470	0.07060	251	252
	1978	25	0.00005	0.09270	1.72587	259	0.08	0.07830	0.06470	253	251
	1979	25	0.00005	0.13008	1.77642	246	0.1	0.09270	0.07830	259	253
	1980	25	0.00006	0.14746	1.75410	244	0.1	0.13008	0.09270	246	259
	1981	25	0.00005	0.14430	1.66932	251	0.09	0.14746	0.13008	244	246
	1982	25	0.00005	0.13772	1.64800	250	0.1	0.14430	0.14746	251	244
	1983	25	0.00001	0.10907	1.57977	257	0.07	0.13772	0.14430	250	251
	1984	25	0.00005	0.09755	1.58498	253	0.07	0.10907	0.13772	257	250
	1985	25	0.00005	0.08410	1.57769	251	0.08	0.09755	0.10907	253	257
	1986	25	0.00005	0.11516	1.58065	248	0.08	0.08410	0.09755	251	253
	1987	25	0.00005	0.15319	1.55645	248	0.08	0.11516	0.08410	248	251
	1988	25	0.00005	0.16470	1.53414	249	0.07	0.15319	0.11516	248	248
	1989	25	0.00005	0.14220	1.51200	250	0.06	0.16470	0.15319	249	248
	1990	25	0.00005	0.16903	1.44402	259	0.09	0.14220	0.16470	250	249
	1991	25	0.00005	0.15609	1.44141	256	0.09	0.16903	0.14220	259	250
	1992	25	0.00005	0.18859	1.45161	248	0.08	0.15609	0.16903	256	259
	1993	25	0.00006	0.13255	1.46914	243	0.07	0.18859	0.15609	248	256
	1994	25	0.00006	0.13259	1.47280	239	0.07	0.13255	0.18859	243	248
	1995	25	0.00006	0.11721	1.49167	240	0.07	0.13259	0.13255	239	243
	1996	25	0.00006	0.11147	1.44082	245	0.07	0.11721	0.13259	240	239
	1997	25	0.00005	0.11692	1.40891	247	0.07	0.11147	0.11721	245	240
	1998	25	0.00005	0.11813	1.43426	251	0.07	0.11692	0.11147	247	245
	1999	25	0.00005	0.11528	1.48032	254	0.07	0.11813	0.11692	251	247
	2000	25	0.00005	0.11165	1.48276	261	0.07	0.11528	0.11813	254	251
Togo	1970	26	0.00000	0.02768	1.12458	297	0.08	0.11165	0.11528	261	254
	1971	26	0.00005	0.03052	1.14634	287	0.09	0.02768	0.11165	297	261
	1972	26	0.00009	0.02960	1.08970	301	0.09	0.03052	0.02768	287	297
	1973	26	0.00004	0.03599	1.05263	304	0.09	0.02960	0.03052	301	287
	1974	26	0.00004	0.05141	1.00000	312	0.06	0.03599	0.02960	304	301

	1975	26	0.00004	0.05413	1.01923	312	0.07	0.05141	0.03599	312	304
	1976	26	0.00009	0.05822	1.04362	298	0.07	0.05413	0.05141	312	312
	1977	26	0.00004	0.08083	1.03205	312	0.06	0.05822	0.05413	298	312
	1978	26	0.00004	0.11550	0.95562	338	0.06	0.08083	0.05822	312	298
	1979	26	0.00004	0.13032	1.04808	312	0.07	0.11550	0.08083	338	312
	1980	26	0.00004	0.09179	0.92197	346	0.08	0.13032	0.11550	312	338
	1981	26	0.00004	0.06885	0.97214	323	0.07	0.09179	0.13032	346	312
	1982	26	0.00004	0.08678	1.05980	301	0.07	0.06885	0.09179	323	346
	1983	26	0.00000	0.13143	1.09524	273	0.07	0.08678	0.06885	301	323
	1984	26	0.00005	0.12270	1.07914	278	0.08	0.13143	0.08678	273	301
	1985	26	0.00005	0.11784	1.04255	282	0.07	0.12270	0.13143	278	273
	1986	26	0.00005	0.17578	1.11552	277	0.07	0.11784	0.12270	282	278
	1987	26	0.00005	0.12810	1.17910	268	0.08	0.17578	0.11784	277	282
	1988	26	0.00005	0.19729	1.12635	277	0.08	0.12810	0.17578	268	277
	1989	26	0.00005	0.18606	1.11828	279	0.08	0.19729	0.12810	277	268
	1990	26	0.00005	0.24230	1.35185	270	0.1	0.18606	0.19729	279	277
	1991	26	0.00005	0.18785	1.36399	261	0.11	0.24230	0.18606	270	279
	1992	26	0.00006	0.21657	1.42857	245	0.12	0.18785	0.24230	261	270
	1993	26	0.00007	0.10670	1.64039	203	0.12	0.21657	0.18785	245	261
	1994	26	0.00006	0.12322	1.57709	227	0.09	0.10670	0.21657	203	245
	1995	26	0.00011	0.17559	1.56303	238	0.1	0.12322	0.10670	227	203
	1996	26	0.00016	0.13187	1.62948	251	0.09	0.17559	0.12322	238	227
	1997	26	0.00020	0.09531	1.36101	277	0.09	0.13187	0.17559	251	238
	1998	26	0.00021	0.09954	1.40230	261	0.07	0.09531	0.13187	277	251
	1999	26	0.00016	0.05380	1.48450	258	0.06	0.09954	0.09531	261	277
	2000	26	0.00022	0.05310	1.55645	248	0.08	0.05380	0.09954	258	261
Zambia	1970	27	0.00241	0.00547	1.53249	554	0.11	0.05310	0.05380	248	258
	1971	27	0.00248	0.00934	1.61798	534	0.14	0.00547	0.05310	554	248
	1972	27	0.00247	0.00890	1.55417	563	0.15	0.00934	0.00547	534	554
	1973	27	0.00249	0.01615	1.64991	537	0.13	0.00890	0.00934	563	534
	1974	27	0.00253	0.02056	1.60980	551	0.14	0.01615	0.00890	537	563
	1975	27	0.00255	0.03279	1.55577	520	0.17	0.02056	0.01615	551	537
	1976	27	0.00281	0.02200	1.60300	534	0.18	0.03279	0.02056	520	551
	1977	27	0.00276	0.03960	1.64575	494	0.17	0.02200	0.03279	534	520
	1978	27	0.00287	0.06742	1.64865	481	0.21	0.03960	0.02200	494	534
	1979	27	0.00338	0.10473	1.71239	452	0.2	0.06742	0.03960	481	494
	1980	27	0.00267	0.11577	1.72727	451	0.18	0.10473	0.06742	452	481
	1981	27	0.00271	0.07983	1.65659	463	0.2	0.11577	0.10473	451	452
	1982	27	0.00283	0.11214	1.74943	435	0.21	0.07983	0.11577	463	451
	1983	27	0.00001	0.07663	1.82082	413	0.23	0.11214	0.07983	435	463
	1984	27	0.00003	0.08601	1.85427	398	0.23	0.07663	0.11214	413	435
	1985	27	0.00003	0.11540	1.85934	391	0.25	0.08601	0.07663	398	413
	1986	27	0.00004	0.16055	1.86352	381	0.25	0.11540	0.08601	391	398
	1987	27	0.00004	0.14406	1.83905	379	0.28	0.16055	0.11540	381	391
	1988	27	0.00003	0.15326	1.81026	390	0.33	0.14406	0.16055	379	381
	1989	27	0.00004	0.12118	1.82086	374	0.34	0.15326	0.14406	390	379
	1990	27	0.00004	0.15853	1.80886	361	0.36	0.12118	0.15326	374	390
	1991	27	0.00004	0.29057	1.84900	351	0.37	0.15853	0.12118	361	374
	1992	27	0.00004	0.34589	1.91369	336	0.37	0.29057	0.15853	351	361

	1993	27	0.00004	0.27138	1.79943	349	0.28	0.34589	0.29057	336	351
	1994	27	0.00004	0.24640	1.98714	311	0.11	0.27138	0.34589	349	336
	1995	27	0.00005	0.71749	2.07797	295	0.11	0.24640	0.27138	311	349
	1996	27	0.00004	0.20172	1.92533	308	0.13	0.71749	0.24640	295	311
	1997	27	0.00004	0.19752	1.93891	311	0.13	0.20172	0.71749	308	295
	1998	27	0.00005	0.11416	2.00000	298	0.13	0.19752	0.20172	311	308
	1999	27	0.00005	0.19732	1.95302	298	0.12	0.11416	0.19752	298	311
	2000	27	0.00004	0.24502	1.93399	303	0.11	0.19732	0.11416	298	298
Zimbabwe	1970	28	0.00443	0.00002	1.62175	616	0.19	0.24502	0.19732	303	298
	1971	28	0.00415	0.00002	1.56636	648	0.18	0.00002	0.24502	616	303
	1972	28	0.00184	0.00016	1.47267	677	0.18	0.00002	0.00002	648	616
	1973	28	0.00399	0.00006	1.52239	670	0.21	0.00016	0.00002	677	648
	1974	28	0.00394	0.00019	1.44783	690	0.2	0.00006	0.00016	670	677
	1975	28	0.00204	0.00148	1.47023	655	0.2	0.00019	0.00006	690	670
	1976	28	0.00452	0.00152	1.54631	637	0.2	0.00148	0.00019	655	690
	1977	28	0.00240	0.00170	1.61217	575	0.19	0.00152	0.00148	637	655
	1978	28	0.00257	0.00266	1.65314	542	0.2	0.00170	0.00152	575	637
	1979	28	0.00302	0.00349	1.62362	542	0.2	0.00266	0.00170	542	575
	1980	28	0.00208	0.03633	1.50084	599	0.22	0.00349	0.00266	542	542
	1981	28	0.00212	0.03547	1.35285	649	0.22	0.03633	0.00349	599	542
	1982	28	0.00217	0.04152	1.32969	640	0.23	0.03547	0.03633	649	599
	1983	28	0.00212	0.04069	1.34560	625	0.21	0.04152	0.03547	640	649
	1984	28	0.00234	0.05924	1.39389	589	0.23	0.04069	0.04152	625	640
	1985	28	0.00225	0.04287	1.39604	606	0.2	0.05924	0.04069	589	625
	1986	28	0.00252	0.04064	1.44631	596	0.21	0.04287	0.05924	606	589
	1987	28	0.00488	0.05103	1.55422	581	0.23	0.04064	0.04287	596	606
	1988	28	0.00473	0.04484	1.46766	603	0.22	0.05103	0.04064	581	596
	1989	28	0.00469	0.04033	1.42345	614	0.26	0.04484	0.05103	603	581
	1990	28	0.00422	0.04970	1.39404	637	0.23	0.04033	0.04484	614	603
	1991	28	0.00419	0.05475	1.40763	655	0.27	0.04970	0.04033	637	614
	1992	28	0.00465	0.12241	1.58692	581	0.3	0.05475	0.04970	655	637
	1993	28	0.00478	0.07671	1.50348	574	0.23	0.12241	0.05475	581	655
	1994	28	0.00466	0.07735	1.36911	615	0.21	0.07671	0.12241	574	581
	1995	28	0.00275	0.06817	1.39339	605	0.21	0.07735	0.07671	615	574
	1996	28	0.00261	0.04740	1.25723	657	0.19	0.06817	0.07735	605	615
	1997	28	0.00242	0.04212	1.21353	665	0.18	0.04740	0.06817	657	605
	1998	28	0.00264	0.03087	1.20741	675	0.17	0.04212	0.04740	665	657
	1999	28	0.00290	0.03169	1.33230	644	0.17	0.03087	0.04212	675	665
	2000	28	0.00272	0.02365	1.35605	587	0.16	0.03169	0.03087	644	675