

**ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES**



**DO INSTITUTIONS MATTER IN POVERTY
REDUCTION? A PANEL EVIDENCE FROM
SUB-SAHARAN AFRICA**



**BY
GEDION MEKONNEN SIYOUM**

JULY, 2007

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REDUCTION? A PANEL EVIDENCE FROM SUB-
SAHARAN AFRICA**



**A Thesis Presented to the
School Of Graduate Studies
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Analysis)

**BY
GEDION MEKONNEN SIYOUM**

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“Do Institutions Matter in Poverty Reduction?
A Panel Evidence from Sub – Saharan Africa.”

By

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Dedication

This piece of work is dedicated to my beloved mother, "dear mama", passed away last May, 2007 due to car accident.



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Abstract

This paper provides a perspective on and review of the relationship between institutions, income and poverty, as it relates to poverty patterns in Sub-Saharan Africa. It tries to analyze the importance of institutions on growth process and poverty reduction in the region. The study employs a random effect error component model to investigate the envisaged relationships in the system of simultaneous equation models of openness, institutions, income and poverty. It is a GMM type random effect model that handles systems of equations simultaneously. It also handles the problems of endogeneity, control individual unobserved heterogeneity and handle unbalanced-ness of the data. Accordingly, while institutions have been shown to have a direct impact on economic performance (income), we argue in this paper for a weak direct relationship between institutions and poverty measures. We find that institutions, as measured by a strong commitment to the rule of law among other things, matter for poverty reduction largely through their effect on economic growth (income). Moreover, the analysis demonstrates that the institutional quality indicators that are related with the economic institutions (government effectiveness, regulatory quality, rule of law and control of corruption) have a stronger impact on income thereby on poverty reduction. Thus taking into account this, the most important institutions to be built or to be strengthened include rule of law (property right), regulatory institutions that stimulate investment, resource allocation and efficiency are more relevant for growth and poverty reduction than the nature of the political system in the region. Thereby we can improve the mapping of growth in to poverty in the region.

Keywords: *Institutions, income, poverty, openness, geography and EC3SLS.*

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Chapter 1

1. Introduction

1.1 Background of the Study

The development of institutions has become central to our understanding of economic growth, development and poverty patterns globally. Because of this, the World Development Report (2002) has focused on building “institutions for markets”. According to the World Development Report, market supporting institutions perform one or more of the following three functions: easing or restricting the flow of information; defining and enforcing property rights; and increasing or decreasing competition. Facets of weak institutions include tangled laws, corrupt courts, biased credit systems and elaborate business registration requirements. These facets, it is claimed, hinder development and hurt poor people (Ali, 2005).¹

The most common understanding of institutions in the empirical literature is due to North (1990). According to North (1990), institutions “are the rule of the game in a society or, more formally, are the humanly devised constraints that shape human interaction. In consequence, they structure incentives for human exchange, whether political, social or economic. Institutional change shapes the way societies evolve through time and hence is the key to understanding historical change”. According to this understanding, institutions include any form of constraints that human beings devised to shape human interaction. These constraints could be formal (such as the rules devised by human beings) or informal (such as conventions or codes or customs). Institutions affect the performance of the economy by

¹ See for detail discussion Ali Abdle Gadir (2005), Institution, growth and poverty.

their effect on the cost of exchange and production.² Building relevant institutions, as generally recognized, is part and parcel of the development process. It is also generally recognized that institutions evolve over long periods of time in response to the demand of social, political and economic interactions. The evolutionary processes involved are influenced by history and culture of societies concerned.

In the context of Africa, an important historical influence on the long term historical process of institutions has been the colonial encounter. Acemoglu *et. al.* (2001), the most influential study on this topic, provides strong evidence. This evidence suggests that where the colonial powers decided to settle they devised what is known as market supporting institutions, while where they decided not to settle they opted for extractive institutions. It is argued that, colonial institutions persisted into the post colonial period. In most of the cases it has been shown that Sub-Saharan Africa is characterized by very weak institutions that have a bearing on the region's poor economic performance and general ability to reduce poverty.

1.2 Problem Statement

In mainstream economics, thinking on how to reduce poverty has evolved over the last couple of decades. This idea is clearly accentuated by Besley and Burgess (2003). They observe that the traditional economic focus in development thinking relies heavily on the neoclassical model in which economic growth was achieved through the accumulation of productive assets in a climate of macro economic stability. This perspective has been

² In a recent contribution Glaeser *et. al.* (2004) note that the key word in North's definition is the word "constraint", thus constitutions and electoral rules are good examples of institutions, good policies chose by dictators who have a free hand or not. Moreover they note that another essential aspect of institution is that the constraints need to be reasonably permanent or durable.

challenged as insufficient both from inside and outside of the economic profession. The primary outside challenge rests on the concern about globalization, the environment, human rights, powerlessness and exploitation. Inside the economic profession, the institutional and political context in which policy and accumulation decisions are made has taken the center stage. The agenda for growth still emphasizes accumulation of physical and human capital in a climate of macro stability, but the framework for achieving growth places greater emphasis on institutional reforms that expand opportunities for households, improve the climate for doing business and improve accountability of elected officials. The current redistribution agenda focuses less on the transfer of money and more on specific policies, particularly public services, credit and property rights, which can be shifted in a pro-poor direction.

In historical terms, poverty has been highly persistent and a slow moving process [Lipton and Ravallion, (1995) cited in Besley and Burgess 2003]. This often led to explanations of poverty based on some underlying factor that was difficult to change such as resource endowment, disease burden or factors relating to geography. However, the fact that poverty did change significantly in some countries and regions calls for another explanation. There seems little doubt that divergent poverty trends in for instance, East Asia and Sub-Saharan Africa are in part a function of the policy and institutional reform implemented in the countries that make up those regions.

Kaufmann *et. al.* (1999) provides firm evidence that institutions are vital for poverty reduction. This study used standardized measures in an econometric model to analyze the

effect of governance on development outcome indicators: per capita GDP, infant mortality rate and the adult literacy rate. Each governance indicator was found to be a significant determinant of the above development outcomes. In a broad sense, these development outcome indicators can be viewed as a poverty measure. Accordingly, improved institutions lead to improved development outcomes such as an increase in per capita income and adult literacy rate and a reduction in the infant mortality rate. These results clearly indicate that there is a large pay-off in terms of per capita income to improvements in governance (Kaufman *et.al.*, 1999).

Albeit, much of the recent works have focused on growth-inequality trade-offs for assessing poverty reduction targets. Demery and Walton (1999), for instance assessed the feasibility of poverty targets in terms of the overall economic growth rates, taking into account inequality in income distribution and policy stance.³ Questions relating to policy reforms, in particular trade liberalization have also been addressed in considerable detail (Demery and Walton 1999, McArthur and Sachs 2002, and Giaha and Imai 2004). While a wide range of issues has been covered and a much deeper understanding of the links between policy reforms, growth and poverty reduction exists, there is little work done in the area of the link between poverty and institutions in the African context. Likewise, the relationship between institutions, economic growth and development is the object of vast literature. The effects of institutions on poverty however, have been less investigated. These literatures in general summarized the underlying factors for slow growth of Africa and persistently high poverty pattern in to three broad concepts. The prevalence of weak

³ Sachs and Warner (1995) classify the sample of countries in terms of good and bad policy stance and political condition to explain variations in growth rates.

institutions, poor geographic conditions and the prevalence of poor policies like lack of trade openness are the major factors. Another strand of literature in recent years has focused largely on growth, institutions and integration (openness). While the later has led to a rich debate on endogeneity of institutions with historical and geographical factors, endogeneity of integration with institutions and linkages between them and growth as well their impact on poverty reduction in sub-Saharan Africa has not been much explored.⁴

This study tries to build on earlier works in several respects. First, it uses a richer database, drawing on various recent sources. Second, it employs a more rigorous methodology to confirm the robustness of the results. In previous studies income, which is claimed to be a channel of transmission between institutions and poverty, is determined exogenously. Here this assumption is relaxed by considering the centrality of agriculture in the development process. Kuznets (1965) argued that a rise in agricultural productivity is a precondition for growth, while Mellor (1976) drew attention to the backward and forward linkages between agriculture and the rest of the economy. An important implication is that agricultural growth impacts on poverty in two ways: directly through its effect on rural poverty and indirectly through its stimulation of the rest of the economy. Therefore, this study tries to examine whether institutions play an important role in poverty reduction in sub-Saharan Africa, while considering endogeneity of institutions, openness and inequality, simultaneity of income and controlling unobserved heterogeneity with an appropriate econometric method. Thereby, it further provides an insight in to somewhat disconnected strands of recent works in sub-Saharan Africa.

⁴ See some contributions in this regard by Acemoglu *et. al.* (2001), Acemoglu *et. al.* (2003), Rodrik (2002), Bardahan (2004), Przeworski (2004) and Gleaser *et. al.* (2004), Giaha and Imai (2005), Ali, (2005)).

1.3 Objective of the study

1.3.1 General Objective

In this study the role of institutions in explaining poverty reduction through various channels will be examined and an assessment will be made regarding the impact of income, inequality and institutions on poverty in an integrated framework in Sub Saharan Africa.

1.3.2 Specific Objectives

The specific objectives of the study are

1. Examine whether institutions matter in poverty reduction.
2. Identify which institutional quality indicator is significant in explaining poverty reduction.
3. Identify and examine other factors that have an impact on poverty reduction.
4. Employ various econometric techniques to ascertain the robustness of the study.
5. Draw some policy lessons.

1.4 Significance of the Study

The ultimate purpose of this study is to complement on-going country-level macro and micro studies on pro-poor growth and inequality. As it is well known, cross-country studies are not substitutes for country-level case studies. Hence cross-country studies of such type can advance our understanding of the poverty reduction process at the country level. Findings from such cross-country studies will be of vital importance to support claims of country specific case studies. As can be discerned from the reviewed literature, most of the recent studies dealt with the traditional econometrics approach (cross-sectional

econometrics methodology). The proposed study has therefore some importance from the methodological perspective.

1.5 Hypothesis

Following the thorough discussion in the previous sections, the study ponders on the following hypotheses and will identify the signs and size of each covariate employed in the study. The main hypotheses of the study are;

1. Institutions are assumed to have an impact on poverty through income channel (growth process). Thus, institutional quality indicators (rule of law, government effectiveness, checks on corruption,) are hypothesized to influence income positively through greater investment. Since institutions play an important role in protecting security of property that serves as a powerful incentive to invest and accumulate physical capital. Thereby, income and poverty will have a negative association.

2. According to the theoretical and empirical researches reviewed, better institutions are believed to have a direct impact on poverty reduction. Better institutions and lower uncertainty will ultimately improve the mechanisms, the effectiveness and the efficiency of public service delivery especially in the rural areas thus, the expected sign of the coefficient is negative.

1.6 Limitations of the study

This study sheds light on the role of institutions on poverty reduction in Sub-Saharan Africa, however it suffers from certain limitations. One of the serious limitations of the study is unavailability of data on certain key instruments such as settlers' mortality,

ethnolinguistic fractionalization, land and human capital inequality. This limits the study to focus on geography components and lagged measures to exploit exogenous sources of variation in institutions and income inequality respectively. The other limitation pertains to the unbalanced-ness and inconsistency of data from various sources, and there is no clear information on how those data are generated. Hence, the results can likely be affected. Also, the lack of long time series of institutional data, limits the analysis in detecting long run relationship.

Finally, some of the factors used in the study are time invariant and highly persistent variables. Thus, the study could not use alternative estimation method like GMM for robustness checks. However, compared with pooled OLS and error component single equation estimations, our result is better.

1.7 Organization of the paper

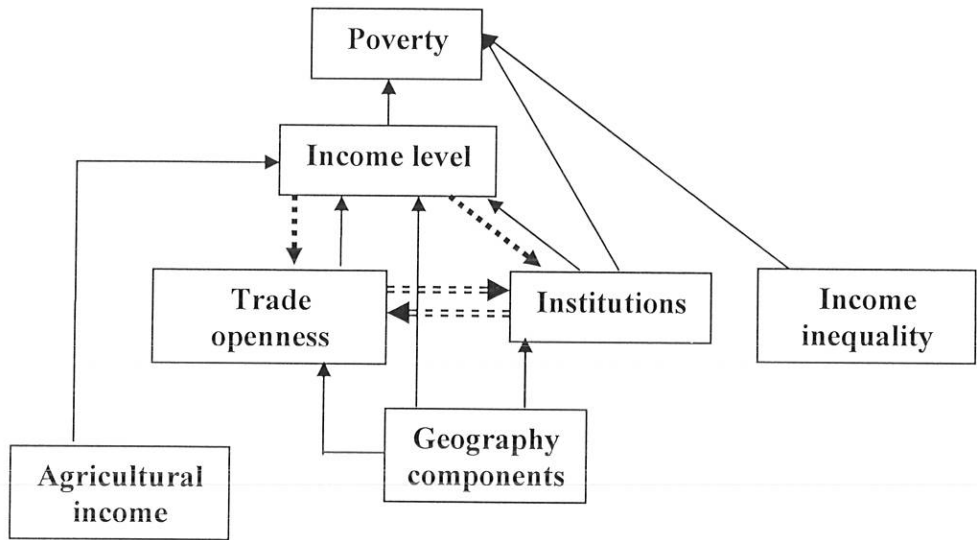
The remainder of the paper proceeds as follows. Chapter 2 provides a brief review of the empirical and theoretical literature on institutions, openness, geography, agriculture and poverty in sub-Saharan Africa, as well as the role of institutions with an emphasis on evidence on African countries. Chapter 3 describes the empirical methodology. The data and discussion of the estimation results are provided in Chapter 4. The final section, chapter 5 provides the concluding remarks.

Chapter 2

2. Literature Review

Much has been written on the area of economic growth, institutions and development. The present study compiles the most relevant and recent sources concerning the research theme. However, this is not to pretend that the study covers all related works but most pertinent and recent ones. Prior to providing detailed theoretical and empirical foundations, a schematic description of the integrated framework used is given in Figure1. The state-of-knowledge about these links is explained below. This framework comprises three sets of relationships. First, it identifies and assesses the determinants of institutions (e.g. historical and geographical factors) and openness (e.g. institutions, geographical factors). In the second stage, it focuses on the determinants of per capita income (e.g. lagged agricultural per capita income, openness, geographical factors, institutions). Finally, it analyses the determinants of poverty (e.g. income, income inequality and institutions).

Figure. 1 Factors that explains cross country variations in poverty



Adapted from: Rodrik *et al.* (2004), Gaiha and Imai (2005) and others.

- , represents the direction of causation.
-→ , represents the reverse causality. and
- ==→ , shows that two way relationship.

Therefore, the rest of the literatures review in subsequent sections as well as the entire analysis concentrate on this framework.

2.1 Growth, Poverty and Inequality in Africa

It is generally recognized that Africa’s growth during the period since independence and up to the first oil price shock of 1973 was on par with other regions. Since that time, however, economic growth faltered first and then a process of decline started. Thus, for example, during the 1980’s, per capita GDP declined by 1.3 percent per annum, a rate that was 5 percent point below the average of all low-income developing countries. During the first half of the 1990’s the growth situation further deteriorated such that per capita GDP

declined by an annual rate of 1.8 percent per annum, a rate that was 6.2 percentage points below the average for low income developing countries (Collier and Gunning, 1999).

To understand the prevailing patterns of growth in Africa, several country case studies have been undertaken to explain Africa's economic growth performance. O'Connell (2004) summarized the major emerging lessons with emphasis on political economic concerns as: when institutions are weak, the ex-ante variance of growth – even medium run growth may be dominated by uncertainty about the quality of executives. The evidence suggests that ethno-regional interest had a profound effect on the growth process in a number of sub-Saharan African countries. Other evidence shows that a narrow interest group, occupying power is capable of choosing ex-ante growth ruinous policies. In fact O'Connell has explained the non-sustainability of rapid growth episodes in Sub-Saharan Africa in terms of cycles in government expenditure.

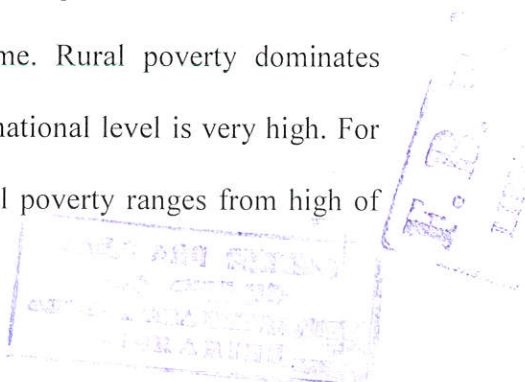
Besely and Burgess (2003) also provide evidence that growth has the lowest impact on poverty in sub-Saharan Africa and the historical growth rate is by far the lowest. Thus, the growth rate needed to reduce poverty in this region between 1990 and 2015 is 28 times its historical average. Their analysis supports the view that higher growth translates into poverty reduction. However, for much of the world, the amount of growth that is needed to reduce the poverty rate is large relative to historical averages. This insight has two main implications. First, finding ways to increase economic growth is important to reduce poverty. To attain this aim, uncovering specific institutional and other drivers of growth at the local level in different parts of the world – that is, the microeconomics of growth –

should be one area of focus. Second, economic growth by itself seems unlikely to be enough to cut the poverty rate. Thus, it will be necessary to identify policy and institutional changes that can directly reduce poverty by improve the mapping of growth onto poverty (Besely and Burgess, 2003).

Acemoglu *et. al.* (2001) examine the relationship between income per capita and security of property rights in a cross-section of countries. Using their estimated coefficient, they found that an increase in protection of property rights across the globe of half of one standard deviation would be sufficient to halve global poverty. In a similar vein, using Hall and Jones (1999) social infrastructure as a measure of institutions, Besely and Burgess (2003) found that an increase in social infrastructure of two standard deviations would be sufficient to reduce global poverty by half.

The most recent estimates of poverty by world regions are reported in Chen and Ravallion (2004). According to this estimate, in the early 1980's, Sub-Saharan Africa (with head count ratio of 0.42) ranked as the third highest poverty incidence of all developing region with East Asia and South Asia ranking as the highest and second highest. By 1984, Sub-Saharan Africa became the second highest and by 1987 it became the highest poverty incidence region. By the beginning of the 21st century, the region was by far the poorest among the developing world with about 50 percent of its population living below the poverty line of USD 1.33 per person per day in 1993 PPP.

Apart from the global estimates of poverty, there is evidence to suggest that sub-Saharan Africa's poverty is dominated by rural poverty. Ali (2001), for instance provided detailed estimates based on country specific poverty lines for the rural, urban and national level. Based on his analysis, the basic evidence is summarized as; sub-Saharan Africa rural poverty is characterized by high level of capability deprivation as reflected by educational enrollment, literacy rates, access to sanitation and access to clean potable water. African rural poverty is widespread, deep and severe as reflected by conventional money metric measures and rural poverty is characterized by a very low response to its fundamental determinants: economic growth and distribution of income. Rural poverty dominates African poverty in a sense that its share in total poverty at national level is very high. For example, the share of rural poverty in the incidence of total poverty ranges from high of 91% to a low of 62% (Ali, 2001).



While discussing growth and poverty, inequality in income distribution is also one of the serious matter in the region. The Deininger – Squire (1998) data set on income distribution shows that Africa is one of the most unequal regions in the world next to Latin America. Bigsten and Shimeles, (2004) investigated some dimensions of income distribution in Africa. Their analysis showed that the Gini coefficients in Africa are concentrated in the range of 40 – 55 percent; hence, income distribution is a serious concern in Africa. They underlined the importance of complementing the analysis of growth policies with the distributional consequences. The vitality of the institutional environment and governance conducive for pro-poor growth strategies is a focus of this study (Bigsten and Shimeles, 2004).

In general, for poverty reduction some forms of inequality matter more than others. Inequality in distribution of assets especially land, human capital, financial capital and in access to public assets such as rural infrastructure is important for poverty reduction. Broadly speaking, a pro-poor growth strategy should therefore reduce poverty and current income inequality while facilitating access to income generating assets and promoting employment opportunities for the poor (Gaiha and Imai, 2005). The present study sheds more light on some key elements of a pro-poor strategy of growth, with a focus on institutional quality. The institutional framework that is vital to foster the growth impact on poverty and inequality is the concern of this study.

2.2 Institutions and Economic Growth

2.2.1 Theory of Institutions

North (1990) defined institutions as the rule of the game in a society; more formally, Institutions are the humanly devised constraints that shape human interaction. Thus, they structure incentives in exchange, whether political, economic or social. Institutions affect economic performance by determining (along with the technology used) the cost of transacting and producing. According to North, institutions consist of both informal constraints (sanctions, taboos, customs, traditions and codes of conducts), and formal rules (constitutions, laws and property rights). This study therefore, considers the later component of institutions.

Institutions evolve incrementally connecting the past with the present and the future; history in consequence is largely a story of institutional evolution in which historical

performance of economies can only be understood as part of a sequential story. Institutions provide the incentive structure of an economy: as that structure evolves, it shapes the direction of economic change towards growth, stagnation or decline (North, 1990).

Acemoglu *et. al.* (2001) also suggests that institutional quality is a fundamental determinant of economic development. Acemoglu *et. al.* (2001) base their theory on three premises of historical perspective: first, they note that Europeans adopted different type of colonization strategies, at one end of the spectrum, Europeans settled and created institutions to support private property and check the power of the state, at the other end of the spectrum, Europeans did not aim to settle and instead sought to extract as much from the colony as possible. In this case, they did not create institutions that supported private property rights; rather they established institutions that empowered elites to extract minerals (e.g. Congo, Burundi, Ivory Coast, Ghana etc).

The second component of the Acemoglu *et. al.* (2001) theory holds that the type of colonization strategy was heavily influenced by the feasibility of settlement. In areas where the environment created mortality among potential settlers, Europeans tended to create extractive states. In areas where the geography favored settlement, Europeans tended to form settler colony. The final pieces of the Acemoglu *et. al.* (2001) theory of institutional development stresses that the institutions created by European colonizers persisted after independence. Settler colonies tended to produce postcolonial governments that were more democratic and more devoted to defending private property rights than extractive colonies. In contrast, since extraction colonies had already constructed institutions for effectively

extracting resources, the postcolonial elites frequently assumed power and readily exploited the pre-existing extractive institutions. This proposition is also strongly supported by the geography theory of Easterly and Levine (2003). According to this theory, differences in endowments shaped initial institutions and these institutions have had long lasting repercussions on the protection of private property rights and other institutions.

Hall and Jones (1999) constitute another example, which follows the geography view of institutions. They use institutional quality as one component of their “social infrastructure” which explains productivity with distance from equator along with European language as an instrument. Their reasoning behind this is that western Europeans have historically been associated with high quality institutions and they settled in climates similar to Western Europe. Kaufmann *et. al.* (1999) also use similar reasoning by using percent speaking English and percent speaking other European language as an instrument for their institutional variable, obtaining a strong effect of these on per capita income.

2.2.2 The Channels of Transmission

According to the Neo-classical theory, the main determinants of economic growth are accumulation of physical and human capital as well as productivity change. Several studies have examined the channels through which institutions affect economic growth. Rodrik *et. al.* (2004), for instance, regressed income per worker, physical and human capital per worker as well as total factor productivity (strictly speaking labour augmenting technological progress parameter) on institutions, integration and geography. They found that institutions are important determinants of both accumulation and productivity factors.

Based on their results, institutions have a larger impact on physical accumulation than on human capital accumulation or productivity. One possible explanation for this is that institutions play an important role in protecting security of property that serves as a powerful incentive to invest and accumulate physical capital. According to Rodrik *et. al.* (2004) one of the mechanisms through which the transmission channel works is investment.

Other studies have also examined the channels through which institutions affect economic growth. Dawson (1998) found that economic freedom affects growth directly and indirectly through enhanced investment. Gwartney *et. al.* (2004) found similar results. Cole (2003) reported that investment will exert a stronger positive impact on growth in countries with greater economic freedom. Gwartney *et. al.* (2006) have also examined the relationship between institutions and investment, and analyzed how institutional quality influences growth through its impact on both the level and productivity of investment. Their results illustrate the fact that countries with higher quality institutions achieve more growth per unit of investment and attract a higher level of private investment as a share of GDP.

While one of the channels through which the effect of institutions translates in to growth and thereby income is investment, there is also another mechanism that works. Meon and Weill (2003) studied how differences in the quality of institutions explain cross country difference in aggregate efficiency using a stochastic frontier approach. They found that better governance is associated with greater efficiency. The main contention is that not only does bad governance reduce the accumulation of factors of production but it results in a

waste of the utilization of existing resources. While several studies provide convincing evidence on how institutions affect economic performances, the above empirical studies suggested that among several mechanism; investment and efficiency are the major channels of transmission.

2.2.3 Institutions and Growth

What are the fundamental causes of the large difference in per capita income across countries? Although there is still little consensus on the answer to this question, differences in institutions of property rights have received considerable attention in recent years. Countries with better institutions, more secure property rights, and less distortionary policies will invest more in physical and human capital, and will use these factors more efficiently to achieve a greater level of income (Acemoglu *et. al.* 2001). North and Thomas (1973) view institutions differently from their predecessors, which implicitly assume that institutions would arise endogenously, and effortlessly as a by-product of economic growth but North and Thomas postulate that institutions are the precondition for and determinants of growth.

Olson (1996) asserts that the key elements in economic development are policies and institutions. While industrialized economies seem to have achieved most of their potential, many developing countries do not appear to have fulfilled theirs, sometimes in spite of their vast resources. The problem, Olson argues, is that poor countries do not have a well developed structure of incentives to bring forth production cooperation. Such a structure

depends on economic policies as well as the quality of institutional arrangements; for instance legal systems that enforce contracts and secure property rights.

To determine the main determinants of economic growth, Rodrik *et. al.* (2004) have estimated the respective contribution of institutions, geography and trade on the income level globally using recently developed instrumental variables for institutions and trade. Their findings indicate the quality of institutions as an important explanatory variable for income. Once institutions are controlled for, the conventional measure of geography (distance from equator) has at best weak direct effect on income rather it has an indirect effect by influencing the quality of institutions. Similarly, once institutions are controlled for, trade is almost always insignificant and often enters the income equation with wrong (i.e. negative) sign. Easterly and Levin (2003), attempted to address the questions of whether economic development depends on geographic endowments or whether do these endowments affect economic development only through institutions and policies. They used cross-country regression analysis to explain variations in endowments, institutions and policy views against each other. The results of this study clearly indicate that endowments affect development through institutions. In their results, there is no clear evidence that mirrors the direct effect of endowments on income other than through institutions. In a similar vein, they find no support for the effect of policies on development after controlling for institutions. However their work does not investigate the detailed effect of openness/trade on development.

In line with these views, Hall and Jones (1999) constructed a measure of social infrastructure, which is the average of an index of the extent to which property rights and contracts are enforced and respected in the country, and the degree of openness to international trade. This measure is intended to capture the institutions and government policies that determine the economic environment within which individuals accumulate skills and firms accumulate capital and produce output. The result substantiated a strong association between social infrastructure and output per worker. Consequently, Hall and Jones argued that social infrastructure is an important determinant of growth.

There are conflicting issues concerning primacy, endogeneity or reverse causality of institutions in different strands of literature. Przeworski (2004), for instance, illustrated that if institutions constitute a primary cause, they can not be caused by something else. In his explanation he states geography as temporally and logically prior to everything else. Accordingly, if geography uniquely determines the initial institutions, which subsequently shape development, geography is still the main source of growth. To be a primary cause, institutions must arise at least to some extent independently of the antecedent conditions. Endogeneity, however, also arises when consequences feed-back into the original causes. If institutions shape development but development affects institutions, then institutions are endogenous with regard to their consequences. The feed-back mechanism need not be functionalist; it need not be that institutions are chosen considering their consequences, nor that only those institutions that promote development survive. Kaufmann and Kraay (2002) studied whether there exists reverse causality between governance (institutions) and income. They propose an empirical strategy that allows for separation of the strong positive

causal effect running from better governance (institutions) to higher per capita income and a weak and even negative causal effect running in the opposite direction from per capita income to governance. The result confirms the existing evidence that most of the variations in governance (institutions) are accounted for by only two variables – income and history. In contrast, for more reasonable values of measurement error in governance (institutions), they find that income and history play a smaller role in understanding cross-country differences in governance (institutions). This finding is similar to that of North and Thomas (1973).

According to Przeworski (2004) endogeneity implies that nothing is considered as the primary cause. Institutions are not a deeper cause than is the supply of factors or technology. Institutions may determine the supply of factors and their use, but these factors, in turn, affect growth and future wealth, which affect the evolution of institutions. Hence, in the end, the motor of history is endogeneity. From some initial circumstances and under some invariant conditions, wealth, its distribution and the institutions that allocate factors and distribute income are mutually interdependent and evolve together. Since it is difficult to completely specify this process, Przeworski concluded to observe some randomness. In fact, he exploited this randomness to identify the particular model of this process: for identification it is vital to observe values of causes under some observable conditions. He basically leaves this as a paradox, i.e. the better we specify our models the more endogenous loops we consider; the more difficult it becomes to identify their causal structure (Przeworski, 2004).

With the notion that institutions do not matter, Glaeser *et. al.* (2004), revisit the debate on whether political institutions cause economic growth, or whether, alternatively, growth and human capital accumulation lead to institutional improvement. They find that most indicators of institutional quality used to establish the proposition that institutions cause growth are constructed to be conceptually unsuitable for that purpose. They also find that some of the instrumental variable techniques used in the literature are flawed. Basic regression results, as well as a variety of additional evidence, suggest that human capital is a more basic source of growth than are institutions, poor countries get out of poverty through good policies, often pursued by dictators, and subsequently improve their political institutions. Importantly, in their framework, institutions have only a second-order effect on economic performance. The first order effect comes from human and social capital, which shapes both institutional and productive capacities of a society. The basic departure from the institutionalists' (Acemoglu *et. al.* 2001, Rodrik *et. al.* 2004 etc) view is that they are highly skeptical on the ground that the indicators represent "ex-post" outcomes, highly correlated with economic development, rather than political constraints per se. They argue that institutions are not the primary causes of growth (Glaeser *et. al.* 2004).

In another front, Bardhan (2004) points to an excessive preoccupation with institutions that safeguard secure property rights and neglect those that prevent coordination failure. In particular, his study emphasizes the important role of the state as a catalyst and coordinator in the financial market. In his econometric analysis, rule of law and weak political rights, instrumented by a measure of state antiquity designed to capture institutional residues of a long history of state structure and bureaucratic culture, even after the colonial interregnum,

and ethno linguistic fragmentation, are significant determinants of income. While Glaeser *et. al.* (2004) assert the unimportance of institutions in growth on the basis of a few selected indicators, Bardhan's (2004) econometric analysis does not go beyond identifying some additional instruments in an arguably incomplete specification of the income equation with only institutional measures as the explanatory variables in 2SLS regressions.

Contrary to the above findings, Dollar and Kraay (2003) investigate the partial effects of institutions and trade on growth. They argue that cross country regressions of the log-level of per capita GDP on instrumented measures of trade and institutional quality are uninformative about the relative importance of trade and institutions in the long run, because of the very high correlation between the two variables. In contrast, regressions of changes in decadal growth rates on instrumented changes in trade and changes in institutional quality provide evidence of a significant effect of trade on growth with a smaller role for improvements in institutions. These results suggest of an important joint role for both trade and institutions in the very long run, but a relatively larger role for trade over shorter horizons.

Institutional development can overcome the disadvantage of geography. To explain this notion, Rodrik (2002) used the example of Mauritius, which is a tropical country with a high degree of dependence on export of commodities affected by terms of trade shocks. Botswana, which has an added disadvantage of being land locked, has obviously not suffered greatly from being geographically disadvantaged either. Botswana and Mauritius

both started out with extremely poor initial conditions and performed well. Good institutions, therefore can overcome geographical constraints and poor initial conditions.

2.3 Trade Openness

Whereas institutions affects income as explained above, there is also a mechanism through which trade openness raises income. To shed some light on this issue, Frankel and Romer (1999) examined the impact of trade on income. They decomposed income in to two. The first decomposition, following Hall and Jones (1999), comprises output per worker as a function of capital depth, schooling and productivity. The second decomposition of income specifies income as a sum of initial output per worker and change during the sample period. They use both in an instrumental variable estimation and results suggest that trade increases income through various component of income. For their first decomposition, the estimated impact of trade on physical capital depth and schooling are moderate, and its estimated impact on productivity is large. For the second decomposition, estimated effect of trade on both initial income and subsequent growth are large. Based on this analysis, the main channel through which trade raises income is through physical and human capital accumulation as well as productivity (efficiency).

Frankel and Romer (1999) also argue that geography matters for economic development through government policy, specifically trade openness. They argue that openness per se has a strong causal effect on per capita income using an instrument for openness with a country's natural propensity to trade based on the gravity model. In the gravity model, predicted trade between two countries increases with the area and population size of the

trading partner and decreases with distance between countries. They investigate the question of how international trade affects the standard of living. To address the endogeneity problem, they focused on the component of trade that is due to geographic factors. The results of the experiment are consistent across samples and specifications considered: trade raises income. Trade appears to raise income by increasing the accumulation of physical and human capital, and by increasing output for a given level of capital. An influential article by Sachs and Warner (1995), in this regard went so far as to argue that countries that are open to trade experience unconditional convergence to the income level of rich countries. These findings imply that openness is an important factor in explaining cross country variations in income.

2.4 Geography

Another strand of factors that are presumed to affect income directly or indirectly is geography. The geography proposition postulates that the environment directly influences the quality of land, labor and production technologies (Machiaveli, 1519, Montequieu, 1748 cited in Easterly and Levine, 2003). For example, compared to temperate climates, a tropical environment tends to have poor crop yields, more debilitating diseases, and endowments that cannot effectively employ production technologies developed in temperate zones (Kamarck 1976; Diamond 1997 cited in Easterly and Levine, 2003). Similarly, particular geographic circumstances such as landlocked-ness and therefore not open to trade, will permanently limit the country's ability to access a large economic market, hinder its ability to exploit economies of scale and thereby lower its production efficiency (Sachs and Warner, 1995). Resource endowments, like minerals or ecological

conditions favoring cash crops, may also influence income. According to the geography hypothesis of Easterly and Levine (2003), the environment shapes economic development directly by influencing the inputs in the production function and the production function itself, i.e. certain endowments could make production technologically more difficult.

Sachs and Warner (1995) suggest that tropical locations, landlocked-ness and commodity dependence directly inhibit development and growth. Bloom and Sachs (1998), and Sachs (2001) argue that tropical location leads to underdevelopment through mechanisms such as; the fragility and low fertility of tropical soils, high prevalence of crop pests and parasites, excessive plant respiration and lower rate of net photosynthesis, high evaporation and unstable supply of water, lack of dry season, cold temperature or enough summer days for temperate grain crops, ecological conditions favoring disease, lack of coal deposits and high transport cost.

Geography can also influence economic performance through various channels. The main channels through which geography influences economic performance are either directly affecting income through its effect on agricultural productivity and morbidity (Rodrik *et al.* 2004). Geography can also have an indirect effect through its impact on distance from markets and the extent of integration or its impact on the quality of domestic institutions. With regard to the latter, economic historians have emphasized the disadvantageous consequences for institutional development of certain patterns of factor endowments, which causes extreme inequalities and enable the entrenchment of small group of elites, (Engerman and Sokolof, 1994). A similar explanation, linking ample endowment of natural

resources with stunted institutional development, “resource curse” is given by Sala-I-Martin and Subramanian, (2003).

McArthur and Sachs (2002) also discuss the role of geography and institutions in determining economic performance. They accept the Acemoglu *et. al.* (2001) cases for importance of institutions, but their more general specifications showed that the disease environment and health characteristics of countries (a measure of geography) matter for economic performance. In particular, they extend the work of Acemoglu *et. al.* (2001) by controlling for the life expectancy and infant mortality, and they instrument for these health variables using geographic variables such as latitude and average temperature.

Rodrik (2002) asserted that geography plays a direct and obvious role in determining income because natural resource endowments are shaped by it to a larger extent. The quality of natural resources depends on geography. Commodities such as oil, diamond and copper are marketable resources that can be an important source of income. Soil quality or rainfall determines the productivity of land. Geography and climate determine the public health environment and shape the quality and quantity of human capital. According to Rodrik (2002), geography also influences growth via openness (integration) and institution. Geography is an important determinant of the extent to which a country can become integrated in the world markets, regardless of the country’s trade policies. A distant land locked country faces greater costs of integration. Similarly, geography shapes institutions in a number of ways. The historical experience of colonialism has been a key factor in institutional development of today’s developing countries. The natural resource endowment

bequeathed by a country's geography also shapes the quality of institutions. This is one possible basis for using geography components as instruments to explain exogenous source of variations in institutions and openness.

Contrary to the above findings, in examining the role of geography, Rodrik *et. al.* (2004) experimented with a series of specifications that involved interacting the different geography variables with each other, as well as introducing different functional forms. The result did not provide evidence in favor of an additional significant direct effect of geography on income. They concluded that there seems to be some, albeit modest, support for a direct effect of geography on income. However their first stage regression favors an important indirect role of geography via institutions.

Gallup *et. al.* (1998) claim that some effects of geography are mediated by policies and institutions. Good policy and institution may have a tendency to go together. The result is that natural differences in growth potential tend to be amplified by the choice of economic policies. Yet their central claim remains that geography matters even after controlling for policies and institutions. All these theoretical as well as empirical findings provide strong *priori* ground for using geography as instruments and as an exogenous factor in explaining cross country variation in openness, institutions and income in this study.

2.5 Institutions and Openness

Countries with better institutions and countries that trade more grew faster. Countries with better institutions also tend to trade more. These three stylized facts have been documented

extensively in various studies. Islam and Montengro (2002) in this regard pinpoint the basic reasons as to why open economies have better quality institutions. In a more competitive context, economic agents with poor institutions fare worse than those with better institutions and so have incentives to change their institutions. Second, rent seeking and corruption is harder when there is competition among agents. Third, as the number of trading partners increases, better institutions are demanded to manage risks that arises trading with unknown partners. Greater risk and greater opportunities work together to break the effectiveness of the existing networks and rules, and create demand for more effective institutions. Fourth, agents in open economies learn from those in other economies and these forces work to improve institutional quality. For all these reasons, better institutions can be expected to evolve faster in more open economies.

In a different dimension, different authors have come to conflicting conclusions on the two way relationship between openness and institutions. Islam and Montenegro (2002) examine the effect of openness on institutional quality. Based on their result, openness is positively and robustly associated with institutional quality. To minimize selection bias, the authors use data sets with the greatest cross-country coverage, though they also test the significance of the variables for small sample size. The result confirm that both natural and policy measures of openness are important. They find that openness in trade is significantly and consistently correlated with measures of institutional quality that focus on economic features such as rule of law, corruption and government effectiveness.

Likewise, there is some discussion in empirical literature of a two way interaction between trade and institutions: better institution foster trade (Anderson and Mercuiller, 1999 cited in Rodrik 2002) and more openness to trade generate higher quality institutions (Wie, 2000 cited in Rodrik 2002).

2.6 Agriculture and Economic Growth

In the developing world as a whole and particularly in Africa, agricultural growth is a vital determinant of the overall economic growth process. Structuralist approaches to development assert that the growth rate of agriculture may have a positive effect on the overall rate of growth of the economy (Saadet and Smith, 1983). Kuznets (1965) argued that a rise in agricultural productivity is a precondition for growth, while Mellor (1976) drew attention to the backward and forward linkages between agriculture and the rest of the economy. An important implication is that agricultural growth impacts on poverty in two ways: directly through its effect on rural poverty and indirectly through its stimulation of the rest of the economy.

Parallel to this, Thirtle *et. al.* (2003) used the World Bank \$ 1 per day poverty line survey and inequality data to establish and quantify the impact of agricultural productivity growth on growth and poverty reduction, by explicitly framing a causal chain model. The result of this approach is a system of equations in which agricultural productivity contributes to growth in GDP per capita, which along with inequality, subsequently has an impact on poverty reduction.

Thirtle and Piesse (2003) also quantify the impact of agricultural productivity growth on the incidence of poverty in developing countries. In contrast to the previous study, this study incorporates governance in its causal chain model. The result clearly supports the outcomes of the previous studies. Despite the widely accepted proposition by Institutionalists, the study uses the flawed assumption of governance as exogenous factor in the causal chain model. Endogeneity, which is the potential problem in this specification, would affect the entire exercise.

Based on the data from the World Development Indicators (WDI), from the sample countries of 29 Sub-Saharan countries, on average 28 % of the Growth Domestic Product (GDP) is constituted by agriculture. However, the variations range from the minimum of 3% (Botswana) and a maximum of 60% by Central African Republic. This simple description, highlights that the importance of agriculture in growth process and poverty reduction in rural areas in the region.

2.7 Institutions and Economic Growth: African Perspective

Several studies have demonstrated the relationship between growth and institutions (Rodrick *et. al.* 2004, Dollar and Kraay 2003, Acemoglu *et. al.* 2001, Kaufmann *et. al.* 1999, Hall and Jones 1999, Sachs and Warner 1995, North 1990). These studies showed that some of the most important institutions like governance, protection of property rights and promoting the rule of law, are weak in most African countries and these have contributed much to poor economic growth as well the persistently high poverty level

While these studies provide clue to the prevailing institutions in Africa, there are several prominent studies on the institution-growth nexus discussed in the African context. Collier and Gunning (1999), for instance, gave varied rationalizations for Africa's lower growth rates, such as, lack of social capital, lack of openness to trade, deficient public service, unfavourable geography and risk, lack of financial depth and high aid dependence. The continent is also characterized by ethno-linguistic fractionalization and inequality, divorce of the government from the mass, uncontrolled corruption and lack of other social capital. The public sector is characterized by low returns. All these factors have created a capital-hostile environment in Africa that lowers the rate of return on investment. Boko (2002) also implied that economic freedom, political rights and civil liberty are beneficial for the growth of African countries.

Nkurunziza and Bates (2003) examined the so called Africa dummy using the systems GMM suggested by Hoeffler (2002) it to measure the impact of political variables on growth. Their finding is consistent with studies of Collier and Gunning (1999) and Boko (2002). Institutions (civil liberty, political rights and democracy) significantly influence growth in Africa. Brempong and Traynor (1999) used a simultaneous equations dynamic panel data technique to analyze the causality between political instability and economic growth in Sub-Saharan Africa. They found a bi-directional relation between political instability and growth in the continent. All these studies presuppose that governance, which is part of institutions, has a profound effect on economic performance in Africa.

Acemoglu *et. al.* (2001) revealed the effect of institutions on economic performance in

Africa by controlling for the effect of distance from equator and a dummy for Africa. Their results suggest that Africa is poorer than the rest of the world, not because of pure geographic and cultural factors but because of worse institutions. To estimate the impact of institutions on economic performance, it is important to have a source of exogenous variation in institutions. With settlement propositions and persistence of early institutions as a basis for current institutions, Acemoglu *et. al.* (2001) used settler mortality as a proxy for current institutions. However, this result is against the proposition that institutions evolve over time. (See North 1990). The result is also inconsistent with the findings of geography fundamentalists (Sacks and Warner, 1995).

In spite of the persistence of poor institutions in Africa, Acemoglu *et. al.* (2003) documented success stories for some countries. They pointed out that per capita income in Botswana grew at 7.7% annually between 1960 to 1998. The proximate reasons for this outcome are: law and order were maintained. Diamond revenues were managed exceptionally well. The bureaucracy was efficient and run along meritocratic line. Hard budget constraints were the rule in the public sector. There were large public investments in education, health and infrastructure. The exchange rate was set at competitive level. Acemoglu *et. al.* (2003) argued that the key to Botswana's success is the institutional arrangements that have protected adequately the property rights of actual and potential investors. They considered Botswana as one good example, achieving better economic performance due to good institutions. This occurred despite adverse initial conditions, including minimal investment during the colonial period and high inequality. The success of Botswana is most plausibly due to its adoption of good policies. These have promoted

rapid accumulation, investment and socially efficient exploitation of resource rent. Consistent with the previous work of Acemoglu *et. al.* (2001), these policies resulted from an underlying set of institutions, institutions of private property that encouraged investment and economic development.

2.8 Institutions and Poverty

Several studies have demonstrated the relationship between institutions and poverty. Kaufmann *et. al.* (1999) used the standardized measures in a causal econometric model to see the effect of governance (institutions) on development outcome indicators such as per capita GDP, infant mortality rate and adult literacy rate. Each governance (institutions) indicator was found to be a significant determinant of the above development outcomes. In a broad sense, each of these development outcome indicators can be viewed as a poverty measure. The result clearly indicates that there is a large pay off in terms of per capita income to improvements in governance (institutions). Ali (2005) used a similar specification to note the impact of institutions on poverty in Africa. Consequently, he noted that per capita GDP explains about 45 percent of the variation in observed poverty among the countries of his sample. As expected, his analysis showed that improvements in institutions reduce poverty in a substantially significant fashion. This holds true for each institutional measure and the composite measure. The explanatory power of the individual as well as the composite measure, however, is very low. This suggests that perhaps institutions exert their effect on poverty through other channels. An obvious channel is the level of development as reflected by per capita GDP (income). To explain such an effect, he used an interaction term in poverty specification and the result showed that the power of

explanation, which significantly increased, is largely due to accounting per capita GDP as a fundamental determinant of poverty.

With the focus on poverty and other social goals, Demery and Walton (1999) assessed the prospects for countries attaining two important Millennium Development Goals by the year 2015. The first one is halving the proportion of people living in extreme poverty and secondly reducing by two thirds the death rate for children. On the basis of recent growth experience and predicted GDP growth rates, they have documented mixed results. On the one hand, about half of the developing countries for which data are available are likely to reach the poverty reduction target. However, with improved economic policy (reflected in the 'openness' index), the number of countries shown likely to achieve the target increases sharply. On the other hand, prospects of achieving the child mortality target are much bleaker. Even under the most favorable scenario, improved female education and high economic growth, mortality rates would be substantially above the target for 2015. The study reviews the types of public action that are needed now if these targets are to be attained. It emphasized the need to focus on policy and institutional reforms needed to achieve well functioning social sectors.

Gaiha and Imai (2005) have specified a simultaneous equation model and estimated a system of equations by 3SLS using cross-sectional average data of the Asia and the Pacific region. The study accounts for endogeneity of institutions, openness and Gini of income distribution. They found that institutions are endogenous to historical factors such as settler's mortality, trade share is endogenous to institutional quality, country size and

measure of physical isolation. After controlling for the endogeneity of these variables, they found that income has a negative effect on poverty, income inequality has a positive effect on poverty and in most of the cases, and institutions have no direct effect on poverty but an indirect effect on income.

Ncube (2006) has also provided a clear perspective and review of the relationship between institutions, growth and poverty in Africa. In many instances, institutions have been shown to have a direct impact on poverty by establishing a direct relationship between institutions and poverty incidence on the basis that institutions are rules that govern interaction between economic agents. The analysis also demonstrates how bad institutions affect economic performance. The study considers various institutional factors for selected African countries and showed that these factors have an impact on poverty in Africa.

A somewhat counterintuitive explanation on the link between institutional quality and poverty is provided by Chong and Calderon (2000). They argue that an institutional reform may impose high transaction cost on the poor and consequently may first increase poverty before reform decreases it. Especially for the poor, transaction cost of such a transition may be relatively high. Eventually, improvements in the quality of institutions will reduce poverty. Better institutions and lower uncertainty will ultimately improve the mechanisms, the effectiveness and the efficiency of public service delivery especially in the rural areas.

In a similar manner, Chong and Calderon (2000) provide cross country empirical evidence on the link between measures of institutional development and poverty over the period of

1960 – 1990 using OLS and 2SLS estimates applied to data from 49 developing countries. According to their findings, improvements in institutional quality are associated with improvements in the welfare of the poor. The degree, severity and incidence of poverty appear to be robustly and negatively linked to development of better institutions. They showed that at least a lower risk of property expropriation, a better quality of bureaucracy and an improved overall quality of the institutions are very likely to reduce poverty.

Apart from cross-country studies, several case studies provide profound evidence on the importance of institutions for poverty reduction. In most of the cases, it is implied that improving property rights, for instance, primarily favors the rich, conjuring up the image of rich owners of capital securing greater rents. However, there is increasing evidence that secure land rights, in particular, are an important vehicle for the poor that may promote both equity and efficiency (Besley and Burgess, 2003). Lin (1992) also showed that the move from collective to household farming in China in 1978 led to a large productivity increase in agriculture. Obtaining property rights over land help poor households to gain access to credit, increase labour supply and improve productivity (see, Besley and Burgess, 2003). These micro findings are consistent with many of the studies discussed above which identify property right as a key determinant of growth in a cross-country scenario.

Chapter 3

3. Model Specification and Estimation Method

3.1 Model Specification

Several earlier studies discussed in the preceding chapter offer insights into institutions, poverty reduction and other perspectives. The respective methodologies however, have some shortcomings. The study by Demery and Walton (1999), for example, relies on a somewhat rigid classification of policy stance into “good” and “bad” and neglects the role of agriculture. The others (Ali, 2005, Gaiha and Imai, 2005, Ncube, 2005) overlook the problems of omitted variables and unobserved heterogeneity. A more detailed analysis is thus necessary that takes account of the role of institutions, openness and the centrality of agriculture in poverty reduction in sub-Saharan Africa, while considering the above problems. Hence an attempt will be made to address such issues with an appropriate econometric model.

Due to the particular interest in poverty of this study, the intent is to observe interactions between income (growth) and institution, and whether openness shapes institution through better economic performance or whether openness itself is shaped by institutions. As there is a vast literature with conflicting evidence, it is opted to address these concerns and then assess the impact of growth, inequality and institution on poverty in an integrated framework. Therefore, the simultaneous equation model drawing on panel data for 29 African countries (1996 – 2005) is specified to address these issues.

The empirical framework comprises four sets of relationships. The first set of relationships is the structural equation model of the study. In this model, income is postulated to depend on lagged per capita agricultural income, institutional quality measures, openness and geography factors.

$$Y_{it} = \alpha + \beta_1 Y_{it-1}^a + \beta_2 O_{it} + \beta_3 D_{it} + \beta_4 I_{it} + \mu_i + U_{it} \quad (1)$$

In the above relationship Y_{it} refers to per-capita income, Y_{it-1}^a designates lagged per-capita agricultural income, O_{it} refers to a measure of openness (integration), D_{it} represents a measure of geography and I_{it} are institutional quality measures designed to capture the influence of political stability, property right, voice and accountability, control of corruption, rule of law and aggregate institutional measure. The μ_i represent country specific unobserved effects (individual heterogeneity) and U_{it} denotes the general equation specific error (the remaining error). The subscripts i and t denote country and time effect respectively.

A lagged measure of agricultural income is included in the model to capture the centrality of agriculture in the growth process in Africa and it is lagged to overcome the complications arising from endogeneity of agricultural income. Thirtle *et. al.* (2003) used the World Bank \$1 per day poverty survey and inequality data to establish and quantify the impact of agricultural productivity growth on poverty reduction. Accordingly, agricultural growth has a powerful impact on poverty in Africa and Asia. It is a more detailed and rich analysis of the role of agriculture in mitigating poverty. However, two issues seem to have

been overlooked, one is the absence of institutions as a key link between endowment and income, and second they take institutions as an exogenous factor in their econometric model. The present study therefore addresses these conceptual flaws.

The basic factor in this structural relationship is institutions. Institutional quality indicators such as rule of law, government effectiveness, checks on corruption and so on, are hypothesized to influence income by inducing greater investment. Given institutional quality and other factors that determine aggregate income, integration with the rest of the world proxied by openness may result in a globally more competitive environment and greater allocative efficiency (Edward 1998, Frankel and Romer 1999), hence openness is assumed to improve growth prospects through total factor productivity. Easterly and Levine (2003) showed that geography explains cross country variations in economic development represented by per capita GDP. Geography is a key determinant of climate, endowment of natural resource, disease burden, transport cost and diffusion of knowledge across space. As such, it has a strong influence on the standard of living of different regions, as measured by per capita GDP (Sachs, 2001). In a similar vein, the geography component of the model is assumed to explain cross country variation in income positively. According to Rodrik (2002), geography is arguably an exogenous factor and it is captured through regional effects, country size (population and area), and historical factors.

A number of previous studies have examined the effect of institutional quality on per capita income using this framework, including Rodrik *et. al.* (2004), Kaufmann *et. al.* (1999), Acemoglu *et. al.* (2001), Easterly and Levine (2003), Dollar and Kraay (2003), and Gaiha

and Imai, (2005). These respective authors made a good theoretical and empirical case for the importance of institutional quality, openness as well as the geography component for growth. In these studies, property rights and rule of law have an obvious effect on incentives to invest and innovate, and openness also affect those incentives and hence growth. The present study, therefore, considers these specifications and the inflicted relationships by incorporating agricultural income in the setup.

Since the study incorporates countries having widely different sizes, all quantitative variables will be expressed in per-capita terms to avoid possible heteroskedasticity in error (Kinal and Lahiri, 1993). In the above specification the dependent variable per capita income and the covariate lagged agricultural income appears in log term.

The second component, which is the reduced form, is a set of exogenous/predetermined factors identified and the impact is shown on trade openness in the following equation:

$$I_{it} = \lambda_i + \delta_1 X_{it} + \delta_2 O_{it} + H_{it} + \mu_i + U_{it} \quad (2)$$

In equation (2), a measure of institutional quality is posited to depend on a vector of geographic variables like latitude, proportion of land area under tropics (X_{it}), openness measure (O_{it}) and a measure of human capital stock (H_{it}). The other symbols are as defined in equation (1).

Acemoglu *et. al.* (2001) on one hand suggested that measurement error in an institutional variable that creates attenuation bias is likely to be more important than reverse causality and omitted variable bias. In reality, the set of institutions that matter for economic performance are very complex, and any single measure is bound to capture only part of the “true institutions”, creating a typical measurement error problem. They also pointed out that the measures of institutions are constructed ex-post, and the analyst may have a natural bias in seeing better institutions in richer places, which will create omitted variable bias. To handle these problems, Acemoglu *et. al.* (2001) suggested the use of appropriate instruments for institutions. Acemoglu *et. al.* (2001) for example emphasize that the European settlers' mortality rate influenced their settlement patterns and the latter resulted in the transplantation of effective European institutions. Where they did not settle, they instituted systems of arbitrary rule and expropriation of local population. Their decision to settle was also influenced by endogenous population density (Gaiha and Imai, 2005). In this regard, Acemoglu *et. al.* (2001) pointed out that among the colonized regions of the world, societies with higher urbanization or population density in 1500 have worse institutions and lower income today. In both cases, indigenous population density and settlers, mortality are used as an instrument to find exogenous sources of variations in income.

Glaeser *et. al.* (2004), however, offer a different perspective on the European settlement pattern, which rests on the primacy of human and social capital in the growth process and a second order effect, through the latter on institutional change. They claim that what the Europeans brought with them was limited government. What is equally plausible is that

“what they brought with them was themselves and therefore their know-how and human capital”. Putting this argument in econometric terms, Glaeser *et. al.* (2004) emphasize that, if European settlement patterns influence growth through channels other than institutions, they are not valid instruments. They acknowledged the fact that settler’s mortality is not an appropriate instrument. This premise motivates us to opt for human capital measures as one possible instrument for institutional factors. Hence, in various alternative specifications this study experiments with institutions specified as endogenous to geographical factors as well as human capital measures. These experiments typically do not include historical factors such as settler mortality as an instrument to exploit exogenous source of variations in institutions mainly due to data problems. Almost half of the sample countries in Sub-Saharan Africa do not have data on settler mortality compiled by Acemoglu *et. al.* (2001).

The third component of the model, which is the reduced form, is the trade openness equation specified as:

$$O_{it} = \theta + \gamma_1 X_{it} + \gamma_2 I_{it} + \gamma_3 O_{it}^N + \mu_i + U_{it} \quad (3)$$

Openness which is proxied by trade volume to GDP ratio is specified to be determined by exogenous geographic variables (X_{it}) such as landlocked-ness, physical isolation, country size (population and area), a two-way relationship with institutions (I_{it}) as well as natural openness index (O_{it}^N) will be used as an instrument to exploit some source of exogenous variations in openness. The other symbols are as defined in equation (1).

The extent to which an economy is open to the rest of the world and the quality of institutions are both endogenous, shaped potentially by each other and geography (Rodrik *et. al.* 2004). To demonstrate causality of these determinants, it is important to capture the direct impact of openness on income and indirect impact through institutions as well as the reverse impact of institutions on openness. It is also strongly emphasized by Islam and Montenegro (2004) that openness per se significantly explains the variations in institutional quality.

The impact of economic growth on poverty is well documented in the empirical literature. Ali (2005) for instance established a simple and powerful relationship between poverty and economic growth by taking into consideration inequality in the distribution of income. His model however, did not account for endogeneity in income and inequality. He has excluded a measure of institutions from the poverty specification, whereas he used it as the key link between growth and poverty. Ncube (2005) has also specified the poverty model in a similar manner but with some modification of including institutional measures in poverty equation. Thirtle *et. al.* (2005) used a causal chain model to explain poverty by inequality, per capita GDP, trade, government expenditure, investment and institutions with an objective of observing the impact of agricultural productivity growth on poverty. It is a more rigorous specification but considers institutions and trade as exogenously given. Gaiha and Imai (2005) however tried to overcome these problems in a cross sectional setting. They considered the endogeneity of income, institutions and income inequality.

The present study adopts this strategy with minor differences using lagged inequality measures as instruments to account for endogeneity. This is mainly due to unavailability of data on land inequality distribution and human capital inequality measures that serve as possible instruments. The fourth set of the structural relationship focuses on determinant of poverty (i.e. proportion of dollar poor and poverty gap ratio). This includes per capita income, income inequality, and institutions. Thus the poverty equation is written as;

$$P_{it}^0 = \delta + \gamma_1 Y_{it} + \lambda_2 G_{it} + \gamma_3 I_{it} + \mu_{it} + U_{it} \quad (4)$$

$$P_{it}^1 = \delta + \gamma_1 Y_{it} + \lambda_2 G_{it} + \gamma_3 I_{it} + \mu_{it} + U_{it} \quad (5)$$

Where P_{it} refers to log of poverty index (i.e. the headcount ratio, (P_{it}^0) or the poverty gap index (P_{it}^1)), Y_{it} is log per capita income, and G_{it} is the log of the Gini coefficient of income distribution. The higher the income, it is hypothesized, the lower would be the poverty. At the same level of income, the greater the inequality; the higher would be the poverty. Institutions may affect poverty either directly by helping to reduce poverty with the expected sign of negative or indirectly through income in the first stage. The other symbols are defined in equation (1).

2.2 Econometric Model and Estimation

Many studies have tried to explain the cross country difference in income and poverty using a cross sectional single equation or simultaneous equation regression framework for average data for long periods like 25 or 30 years (Kaufman *et. al.* (1999), Chong and Calderon (2000), Gaiha and Imai (2005), Ali (2005)). This method has various draw-backs. First it suffers from problems of endogeneity due to unobserved effects. Secondly,

averaging time series variable implies not all information is utilized, thus it is likely to suffer from omitted variable biases (Hoeffler, 2002). Consequently, the right-hand-side variables can be typically endogenous and measured with error.

Considering the foregoing points, this study employs panel econometrics techniques with the specific advantage of controlling for unobserved country heterogeneity. Panel econometrics has an added advantage of providing more information, more variability, less collinearity among variables, more degrees of freedom and more efficiency.

Some of the data representing certain variables derived from various sources are unbalanced or incomplete. In this case, individual observations are missing or are not observed over the entire sample period so that we would have N individual observations observed over varying time period (T_i for $i=1 \dots N$). In general, the regression model with unbalanced one-way error component model disturbances is given by

$$Y_{it} = \alpha + X'_{it} \beta + U_{it} \quad (6)$$

Where X_{it} is a $(K-1) \times 1$ vector of regressors, $i=1 \dots N_i$ and $t=1 \dots T_i$. The above equation is a one way unbalanced error disturbance model.⁵ The error component structure of the j^{th} equation is given by:

$$U_{it} = \mu_{ij} + V_{itj} \quad (7)$$

⁵ One way error component focuses on individual effects only.

Where $\mu_{ij} \sim \text{IIN}(0, \delta_\mu^2)$ and $V_{ij} \sim \text{IIN}(0, \delta_v^2)$, means μ_{ij} and V_{ij} are mutually independent normal random variables with zero mean and constant variance. Besides, μ_{ij} represents the j^{th} cross sectional effect and V_{ij} denotes the remaining error of the j^{th} structural equation.⁶

As mentioned in the preceding section, the problems to address are simultaneity, endogeneity, while controlling for unobserved effect. Further, there is a need to address the problem of unbalanced-ness of the data. There are several instrumental variable estimators which are capable of overcoming the problem of simultaneity and endogeneity by using a within-model and external instruments suggested by Hausman and Taylor (1981), Amemiya and MaCurdy (1986) and others.

Hausman and Taylor (1981) proposed a modified version of the Random Effects model, known as Hausman and Taylor instrumental variable method. It is less sensitive to the lack of knowledge about the unobservable individual effect and does not assume any specification for it. The method can also accommodate the time invariant variables while overcoming the potential correlation between individual specific effect and the other included characteristics (Green, 2003). However, it is a single equation estimation technique that only handles endogeneity due to unobserved heterogeneity.

Amemiya and MaCurdy (1986) provide a better variant of the Hausman and Taylor instrumental variable method. This model handles both endogenous time varying and time invariant characteristics. However, one of the prerequisites of this model is that the panel

⁶ IIN refers to Identically, Independently and Normally distributed.

data should be balanced. In this study, as mentioned, the data is unbalanced and balancing it could greatly magnify the loss in root mean square error (Baltagi, 2001). Further, it requires a strong exogeneity assumption on a set of instruments, with each sets of instrument required to be uncorrelated with the unobserved effect.

These methods provide estimators that reduce to the Fixed Effects (within) estimator if all of the explanatory variables are correlated with the unobserved effects and to the random effects (GLS) estimator if none of the explanatory variables are correlated with the effects. However, with the exception of Amemiya and MaCurdy (1986), none of these studies considers the case in which some of the explanatory variables are endogenous (in the sense of being correlated with the noise component of the error, as well as with the individual effect). Furthermore, Amemiya and MaCurdy consider only limited information (2SLS) estimation, which is not sufficient to a estimate system of equations requiring full information (3SLS). Above all the validity of these approaches, however, depends on the conjecture that serial correlation in the error term is only due to individual specific error. Otherwise simultaneity will be introduced and can not be handled with these approaches.

There are several other options to estimate a system of simultaneous equations specified in section (3.1) (Baltagi and Chang, 2000); Three Stage Least Square (3SLS), has a setback of completely ignoring the error component structure of the disturbance in estimating the system. Within Three Stage Least Square (W3SLS), however it has a drawback of assuming the country specific effect as fixed parameter to be estimated. The Error

Component three stages least square (EC3SLS) accounts for the random error component structure of the disturbance of the model.

3.2.1 Error Component Model

Baltagi (1981), Baltagi and Chang (2000) and others provide various theoretical approaches for a simultaneous equation model estimation with error component models, and possible correlation between unobserved errors and observed explanatory variables. Kinal and Lahiri (1993) propose a simplified algorithm for computing Error Component 3SLS (EC3SLS) estimates by employing an analogue of Fuller-Battese data transformation in a weighted least square framework. The algorithm can be applied to multiple equation panel data models whose regressors are correlated with the disturbances. In cases where the right hand side variables are correlated with the disturbances in an error component model, EC3SLS estimates of multiple equations can be obtained by applying instrumental variable estimation to the transformed equations (Kinal and Lahiri 1993).⁷

In a simultaneous equation framework, identification of the system precedes the estimation. In particular, the inclusion of the right hand side variables should be such that at least one variable for each equation should be distinct in order to meet the rank and order conditions. Therefore, each equation stipulated in section (3.1) has its own distinct explanatory variable in the estimation. In the estimation of a system of equations simultaneity, endogeneity and individual heterogeneity are the problems addressed. This technique

⁷ See the detail representation of Kinal and Lahiri (1993) algorithm for better estimation of the Baltagi's (2001) EC3SLS estimation procedure in the annex -I.

enables us to better evaluate indirect effects and information spillover effects over equations can be tested more reliably (Ulubasoglu and Doucouliagos, 2004).

There are several reasons to specify the relationships discussed in section (3.1) as a system. First; it is possible to place the problem in its natural form and explicitly assign every variable the credit that it deserves in functioning its effect. In this system, the relationship between institutions and poverty is explicitly channeled in a structural setup. Second, a system captures cross equation information in the error terms and provides more efficient estimates. Third, the existence of endogeneity/simultaneity is treated in a system framework, whereby, indirect or direct effect of institutions on poverty is treated explicitly. In addition, the systems estimation procedure accommodates cross equation correlation, and it is implicitly assumed that the correlations between the remaining components of the error term (after adjustment for fixed effects and serial correlation) are independent across individuals and across time.

Given all the problems and issues discussed in this and preceding sections, the preferred methodology is the Error Components Instrumental Variable method. This technique first requires the within and between transformation of each equation, which are subsequently stacked together as indicated below:⁸

$$\tilde{Y}_{it} = \tilde{\alpha} + \beta_1 \tilde{Y}_{it-1}^a + \beta_2 \tilde{O}_{it} + \beta_3 \tilde{D}_i + \beta_4 \tilde{I}_{it} + \tilde{\mu}_i + \tilde{V}_{it} \quad (8)$$

$$\bar{Y}_{it} = \bar{\alpha} + \beta_1 \bar{Y}_{it-1}^a + \beta_2 \bar{O}_{it} + \beta_3 \bar{D}_i + \beta_4 \bar{I}_{it} + \bar{\mu}_i + \bar{V}_{it} \quad (9)$$

⁸ Between transformation is just taking the time average of each individual country in the form of $\bar{y}_i = \phi + \bar{X}_i' \phi_1 + \bar{v}_i$ where $i=1, \dots, N$. This average is replicated for each raw observation of sample countries in the data set.

$$\tilde{I}_{it} = \tilde{\lambda}_i + \delta_1 \tilde{X}_{it} + \delta_2 \tilde{O}_{it} + \tilde{H}_{it} + \tilde{\mu}_i + \tilde{\varepsilon}_{it} \quad (10)$$

$$\bar{I}_{it} = \bar{\lambda}_i + \delta_1 \bar{X}_{it} + \delta_2 \bar{O}_{it} + \bar{H}_{it} + \bar{\mu}_i + \bar{\varepsilon}_{it} \quad (11)$$

$$\tilde{O}_{it} = \tilde{\theta} + \gamma_1 \tilde{X}_{it} + \gamma_2 \tilde{I}_{it} + \gamma_3 \tilde{O}_{Nindex} + \tilde{\mu}_i + \tilde{\varepsilon}_{it} \quad (12)$$

$$\bar{O}_{it} = \bar{\theta} + \gamma_1 \bar{X}_{it} + \gamma_2 \bar{I}_{it} + \gamma_3 \bar{O}_{Nindex} + \bar{\mu}_i + \bar{\varepsilon}_{it} \quad (13)$$

$$\tilde{P}_{it} = \tilde{\delta} + \gamma_1 \tilde{Y}_{it} + \lambda_2 \tilde{G}_{it} + \gamma_3 \tilde{I}_{it} + \tilde{\mu}_{it} + \tilde{U}_{it} \quad (14)$$

$$\bar{P}_{it} = \bar{\delta} + \gamma_1 \bar{Y}_{it} + \lambda_2 \bar{G}_{it} + \gamma_3 \bar{I}_{it} + \bar{\mu}_{it} + \bar{U}_{it} \quad (15)$$

The sign “~” indicates within and “—” represents between version of variations. Before estimation, each equation is premultiplied by within or between transformed vectors of exogenous variables. The intuition behind this technique is that within transformation wipes out the individual specific effects. However, at the same time it eliminates the between type variation across individual countries. For this reason, within transformed equations are supplemented with between transformed versions of the same equation. The transformation process incorporates obtaining the within and between estimates of the Two Stage Least Square of each structural equation, computing the variance component from both estimates and using the Choleski decomposition of the covariance estimated and finally transforming the data by multiplying with the inverse square root of the stacked variance. The transformed data are estimated by 3SLS using STATA (Baltagi, 2001). Hence, to solve endogeneity and simultaneity bias, the stacked system is estimated with instrumental variables using 3SLS.⁹

⁹ Within and between transformations do not solve the inconsistency due to simultaneity; hence appropriate instruments should be applied to resolve such problem. It only controls the unobserved effect and serial correlation in errors. The transformation and estimation procedure proposed by Baltagi (2001) is depicted in annex-2.

Another issue in estimation method is that EC3SLS treats country specific effects μ_i as being random, rather than fixed. This is mainly due to Nerlov and Balestra (1996) and Baltagi (2001). The main premise is that the population consists not only of the infinity of individuals, but also of the infinity of decisions and opportunities. Certainly, the choices of decisions and opportunities used have differed across countries historically and today. Therefore, countries end-up or dealing with different technologies, geographies and institutions (Ulubasoglu and Doucouliagos, 2004). This is ascertained by a Hausman (1978) specification test. The Hausman specification test compares the fixed versus random effects under the null hypothesis that the individual effects are uncorrelated with the other regressors in the model. If correlated (the null is rejected), a random effect model produces biased estimators, violating one of the Gauss-Markov assumptions; so a fixed effect model is preferred. Hausman's essential result is that the covariance of an efficient estimator with its difference from an inefficient estimator is zero (Green, 2003).

Baltagi and Change (2000) compare the performance of several single and system estimators of a two equation simultaneous model with unbalanced panel data. The Monte Carlo design varies with the degree of unbalanced-ness in the data and the variance component ratio due to the individual effects. Based on the analysis, many of the results obtained for simultaneous equation error component model with balanced data carry over to the unbalanced case. For example, both feasible EC2SLS (Error Component Two Stage Least Square) estimators considered in their study, performed reasonably well. They suggested that simple ANOVA (analysis of variance) methods can be applied to obtain estimates of the structural and reduced form parameters in the unbalanced data case rather

than balancing the data. As described above balancing is costly as compared with the gain in efficiency (Baltagi, 2001).

One of the arguments in growth literature is the presence of unobserved individual heterogeneity in cross country studies. The source of this heterogeneity is said to be differences in technology, institutions and geography (Ulubasoglu and Doucouliagos, 2004). In order to control for this unobserved heterogeneity, it is possible to include a dummy for each country so as to look for within country variations over time. However, this results in ignoring an important source of variation by restricting the analysis to the within dimensions of the data. More efficiency can be gained if the cross country variation instead is captured by a random effects model. In this case, since any country specific effects are appended in to the error term, those country characteristics that can be correlated with the right hand side variable should be controlled for, so that random effect estimators are consistent and efficient. This is usually tested by Hausman and Taylor (1981) test. An alternative to this test is a simple Chow test.¹⁰ The test compares the restricted residual sum of square (RRSS) that come from Ordinary Least Square (OLS) estimation using a pooled data set across countries and the unrestricted residual sum of square (URSS) that comes from Within estimation (Fixed effect estimation) of the same specification. In other words this test is to determine whether equations specified in section (3.1) represents the true specification across countries. The null hypothesis tested is $H_0 = \mu_1 = \mu_2 = 0$, that is all individual effects are jointly equal to zero (Baltagi, 2001).

¹⁰ The test statistic is $F = \frac{(RRSS - URSS) / (N - 1)}{URSS / (NT - T - K)} \approx F_{K(N-1), (NT-T-K)}$, Where N is the number of countries, T is the

number of time periods and K is the number of regressors in the estimation.

To ascertain the endogeneity of institutions and openness, the Hausman (1978) test is used. There is an alternative test to identify endogeneity. This test is conducted in two steps. In the first step, the suspected endogenous variables are regressed on exogenous factors in an auxiliary regression. Then in the second step the residuals from this regression are included in to the original model. The significance of the residuals in this model would signal the presence of endogeneity. In this study, there are several suspected endogenous variables; hence the joint significance of these residuals is tested by F-test.

An instrumental variable must satisfy two requirements: it must be correlated with the included endogenous variable(s), and orthogonal to the error process. The former condition may readily be tested by examining the fit of the first stage regressions. The first stage regressions are the reduced form regressions of the endogenous variables on the full set of instruments. The relevant test statistics relates to the explanatory power of the excluded instruments in these regressions (Baum *et. al.* 2003). A statistic commonly used and recommended by Bound *et. al.* (1995) is the R^2 of the first stage regression with the included instruments "partialled out".¹¹ Alternatively, this may be expressed as the F-test of joint significance of the set of instruments in the first stage regression.

The second requirement is that the instrumental variable should be independent of the unobserved error process. This basically works when the equations are overidentified then it is possible to test for the uncorrelated-ness of instruments with the error process. This

¹¹ More precisely, this is the "squared partial correlation" between the excluded instruments and the endogenous regressors in question. It is defined as $(RSS_{Z_2} - RSS_Z) / TSS$, where RSS_{Z_2} is the Residual Sum of Square in the regression of endogenous regressors on Z_2 . RSS_Z is the Residual Sum of Square when the full set of instrument is used.

condition will arise when the order condition for identification is satisfied in inequality: the number of instruments exclude from the equation exceeds the number of included endogenous variables. These are tests of the joint hypothesis of correct model specification and the orthogonality conditions, and a rejection may properly call either or both of these hypotheses into question. One possibility for this test is to use Sargan's statistic having an nR_u^2 form (where nR_u^2 is the uncentered R^2). It can easily be calculated by regressing the instrumental variable (IV) equation's residuals upon all instruments (both included exogenous variables and those instruments which do not appear in the equation). The nR_u^2 of this auxiliary regression have a χ^2_{L-K} distribution under the null hypothesis that all instruments are orthogonal to the error (Wooldridge, 2002).



Chapter 4

4. Result and Discussion

4.1 The Data and Source

This study estimates the models specified in section (3.1) using data on income, trade openness, institutional quality indicators, geography components, agricultural income, poverty and inequality drawn from various sources. The study incorporates a sample of 29 countries for the period of 1996 to 2005.

The poverty data are based on the World Bank estimates where the poverty line is assumed to be US \$ 1 per day at PPP (purchasing power parity) with 1993 as the base year. While the validity of this measure has been debated in much of the literature, the World Bank data set is preferred because it serves as the benchmark for the Millennium Development Goal (MDG) of poverty reduction. There are several measures of poverty, such as headcount index, poverty gap, squared poverty gap, human development index and so on. Panel data on the headcount and poverty gap indices is compiled for the sample period from the World Bank estimated by Chen and Ravallion (2004). This measure is primarily obtained from the PovcalNet database of the World Bank (2005). While Chen and Ravallion (2004) describe the PovcalNet data in detail, the following point is useful to keep in mind. The PovcalNet database presents two types of poverty estimates: actual and synthetic. The former pertain to years in which nationally representative household income and/or expenditure surveys were carried out. The latter pertain to poverty estimates derived for common “reference”

years.¹² The poverty data is unbalanced and covers only a short period; hence some of the missing observations are filled using simple averages keeping consistency among the data. Two measures of poverty are included in the estimation. The first is the headcount index, which is a measure of prevalence of poverty; the main limitation of this measure is that it cannot measure how poor the poor are. For instance, someone in the neighborhood of the poverty line threshold level is not in the same situation as someone with no income at all. The second poverty measure, or poverty-gap index, it measures severity of poverty and deals with this limitation (Please see the definitions in glossary).

Other relevant data (e.g. income per capita, per capita agricultural income, the Gini coefficient of income distribution) is also compiled from the World Bank database (World Development Indicators, 2005). There are several measures of openness developed by Sachs and Warner (1995), and Frankel and Romer (1999). However, due to the problem that the indices developed by these scholars are not of time series nature, this study opted for measure of openness as a ratio of trade to GDP from Penn World (2006) data sets. This indicator is widely used in various papers such as Rodrik (2002), Rodrik *et. al.* (2004). The geography data set comprises various components (distance from equator, country size, land locked-ness, physical isolation index), which are alternatively used in the estimation as regressors and instruments. The data sets are obtained from the Center for International Development (Harvard University) geography data sets. The detailed definitions and source are given in the glossary part.

¹² Since most countries typically carry out the relevant household surveys every 3-5 years, it will be common to find that a survey is not carried out in one of the reference years. In all such cases, poverty estimates are obtained for reference years using the extrapolation methods of Chen and Ravallion (2004).

This study uses a set of governance indicators as a measure of institutional indicators derived from recent sources. Kaufmann *et. al.* (2006), who take the view that many of the existing institutional indicators serve as imperfect proxies for a much smaller number of fundamental concepts of governance or institutional quality. These authors group 31 indicators constructed into six clusters: rule of law, government effectiveness, regulatory burden, graft, voice and accountability and political instability corresponding to three concepts of governance. The first group includes Voice and Accountability which measures the extent to which citizens of a country are able to participate in the selection of governments. Political Instability measures the likelihood of wrenching changes in government. These measures are mostly related with the political institutions. The second group deals with the capacity of the state to implement sound policies. The two indicators in this group are Government Effectiveness, the ability of government to produce and implement good policies and Regulatory Quality, an index of the quality of the policies governments implement. The last group deals with the respect of the state and the citizens for the rules. The two indicators in this case are Rule of Law, which measures the success of a society in developing an environment in which fair and predictable rules form the basis for economic and social interactions and Control of Corruption measures perceptions of corruption. The full data set of country level institutional data is taken from 'World-wide Governance Research Indicators Dataset'. The content of institutional indicators and the methodologies used for constructing them are discussed in Kaufmann *et. al.* (2006).

4.2 Data Descriptives

This study incorporates a sample of 29 countries, the sample is selected not based on the standard sample selection techniques but based on the availability of data on key variables

such as poverty measures, inequality and institutional indicators. The study considered 1996 to 2005 as sample period. The rationale of determining the duration of the panel is based on the availability of institutional data, as the data on institutions from World Bank sources is available only after 1996. Table 1, A-1, and A-2 provide descriptive statistics for the key variables of interest. The summary statistics incorporates simple correlation between the key variables, mean and standard deviations for selected variables.

Table -1 Summary statistics of selected key variables

Variable	Mean	Std. Dev.	Min	Max
Per capita GDP constant	715.584	978.216	104.63	4364.39
Per capita GNP	787.887	1081.011	90.00	5260.00
Log of per capita income	6.082	0.974	4.499	8.568
Per capita agricultural income	98.595	50.299	30.62	277.26
Head count index	41.502	20.315	6.280	85.780
Poverty gap	18.294	13.529	0.560	50.010
Gini coefficient	49.837	10.769	28.900	74.330
Trade openness constant	0.717	0.373	0.170	1.979
Voice and Accountability	-0.432	0.712	-1.748	1.292
Political stability	-0.496	0.834	-2.491	0.975
Government effectiveness	-0.488	0.562	-1.656	0.855
Regulatory quality	-0.397	0.577	-2.271	0.819
Rule of law	-0.543	0.577	-1.663	0.976
Control of corruption	-0.472	0.587	-1.776	1.100
Institutional index (Rule of law)	-0.543	0.577	-1.662	0.976

GNP per capita is the measure of economic performance in the first structural equation of the model (equation 1). For the sample countries, there is substantial variation in income per capita: the mean per capita GNP over the sample period is \$ 788, the standard deviation of log of per capita GNP is 0.974, with the lowest country's (Burundi) per capita GNP being \$ 90 and that of the relatively better one (Mauritius) is \$ 5260.

The institutional quality measures used in the analysis are due to Kaufmann *et. al.* (2006). These are the composite indicators of a number of elements that capture several facets of institutions ranging from the protection afforded to property rights to the strength of the rule of law. The Kaufmann *et. al.* (2006) measures are standardized measures that vary between -2.5 (weakest institution) and 2.5 (strongest institutions). For simple descriptive analysis, we have selected rule of law, which is one of the institutional measure and highly correlated with other measures. In the sample of 29 countries, the mean score for the average index is -0.543, with Zimbabwe (score of -1.662) having weakest institutions and Mauritius (score of 0.976) the strongest. As could be discerned from this simple analysis, Sub-Saharan Africa could be characterized by the prevalence of weak institutions. It is also learned that there is high correlation among the institutional quality indicators. Moreover, the institutions index is positively associated with both economic performance and geography component. More formally, Table A-1 and Figure 2 demonstrate strong positive relationship between the log of per capita GNP and institutional index. Second, Table A-2 and Figure 6 show that in absolute terms institutional indexes are positively correlated with geography components like distance from equator (latitude). This simple relationship is strongly emphasized by Engerman and Sokoloff (1994) who postulate that endowments influence economic development through their impact on institutional development.

Trade openness, measured using the ratio of trade to GDP at constant price, also varies substantially in the sample. The average ratio is 72 percent, the least “open” country (Burundi) has a ratio of 17 percent and the most “open” (Swaziland) a ratio of 197 percent. There are several measures of geography applied in core specifications discussed in section

(3.1). Among the various measures of geography, distance from equator (latitude), physical isolation, country size and density are alternatively used as exogenous variable and instrument. The data indicate a stronger positive association between latitude and economic performance (income). As shown in the Table A-1 and Figure 5 countries with relatively higher absolute latitude tend to have higher level of per capita GNP, however Figure 5 does not show any clear relationships among these factors. Latitude is used as an objective measure of geography in the core income specification.

Regarding poverty data, this study considers the head count index and poverty gap indices as a measure of poverty. The Gini coefficient of income distribution is one variable included in the second core specification (equation 4 and 5). The extent to which these measures are related to economic performance indicators and institutions is depicted in Table A-1 and Figure 7. Both poverty indicators have a negative but an insignificant correlation with institutional factors, while income distribution as measured by the Gini coefficient has positive relationship with institutional factors. One possible implication of this can be that getting these institutional factors right and implementing the right reforms, has the capacity to improve economic growth, thereby reducing poverty but can not effectively improve income distribution. As implied in much of the literature, poverty indicators have the usual strong negative association with per capita income and positive correlation with Gini coefficient of income distribution.

4.3 Regression Result

It is always vital to undertake exploration of the data to be used prior to doing an in-depth analysis. Based on this presumption, we conducted certain diagnosis tests to support the entire analysis. Among others, testing the normality of each variable is conducted using a simple Skewness-Kurtosis technique. Skewness and kurtosis of randomly drawn variables are respectively close to 0 and 3, implying normality. As depicted in Table A-3, the majority of the variables show approximately normal distribution except in cases of some institutional indices, geography variables and Gini coefficient are being skewed to the right and relatively flatter. In conclusion, the numerical methods provide sufficient evidence that the majority of variables are normally distributed.

Given the motivation of controlling for country specific effects, equation (1), which is the core specification of the study, is estimated with pooled OLS (ordinary least square) and Within estimation (Fixed effect estimation) to generate the restricted and unrestricted residual sum of squares respectively for computing the Chow test. The F-statistic of the Chow test is 4.057, which is well above the critical value of 1.46, revealing that the null hypothesis (all the country specific effects are jointly equal to zero) is rejected at 5% level. In a similar manner, the same F-test is conducted for all equations stipulated in section (3.1). Results confirm that cross country functions of institutions, trade openness and poverty equations contain significant country specific effects. The test result suggests that the treatment of the individual effect is necessary and it is appropriate to apply panel estimators. The result is not presented in tables, since the regression result is not used only the residual sums of squares are used to estimate the test.

The country specific effect can be treated either through fixed or random effect estimators. The error component model, which is a random effects model, assumes that the error associated with each cross-section unit is uncorrelated with the other regressors; if this assumption is not satisfied the random effect estimator is biased. Hence, a Hausman test is used to specify whether a fixed or a random effects model is more appropriate. As per this test, the critical chi-square value with three degrees of freedom is 7.81 at 5% level whereas the calculated one from the test is 7.34 at 95% confidence level. This implies that the test fails to reject the non-existence of a systematic relationship between the explanatory variables and the errors, which confirms a random effect estimator is efficient and consistent. The fixed effects model is rejected at the 5% level and this confines the subsequent discussion to the findings obtained from the random effects model, the detailed estimation is illustrated in Table A-6 and A-7.

In the models under consideration, there are several suspected endogenous variables, thus the Hausman (1978) test for endogeneity is conducted as explained in section (3.2).¹³ There is also an alternative test of endogeneity discussed in section (3.2). Both test results in Table A-4 and A-5 show that the residuals from both Institutions and Openness regressions are jointly different from zero in the original model, implying that these variables are endogenous to income.

¹³ The test can be used as test for endogeneity, even if the Hausman (1978) test is meant to be a test of the consequence of employing different estimation methods on the same equation, See Green (2003). The same result is obtained using the alternative test.

The models depicted in section (3.1) represent the core specification of the study. Given the unbalanced-ness of the panel data set, the results are likely to be sensitive to the data and specifications used. There is also no clear information on how those data used in this study are generated, this may affect the result. In addition to this, as described in many studies (Kaufmann and Kraay, 2002), institutional measures are fuzzy set measures, which manifest in terms of precise measurement. So all institutional measures are likely to be problematic. The other concern is that even if there is a unidirectional causal link i.e. from a set of exogenous factors to institutional quality and from the latter to income, whereby institutions in this framework are merely a link in the causal chain, the causality may run both ways in some instances.¹⁴ So while providing evidence regarding the importance of institutions in poverty reduction through higher income, the centrality of institutions rests on the complex chain of causation.

As noted in the data description part, there is a strong correlation among the institutional measures; hence, incorporating all the institutional quality indicators together induces multicollinearity, implying it is not always possible to identify the independent relationships. For this reason, each institutional quality measure is used in the regression in turn.

Kaufmann and Kraay (2002) noted that there is no distinct instrument for each of the institutional indicators; there is no way to interpret the result as capturing the partial effects of each of these variables. However, to the extent that each of these is a proxy for some broad notion of institutions, these estimates can be interpreted as providing a range of

¹⁴ There is an excellent and coherent critique along this line in recent work of Przeworski (2004).

estimates of the effect of institutions broadly constructed on per capita income. Tables 11 to 14 present the error component system (EC3SLS) regressions. Specifically, they examine the role of institutions in explaining cross country variations in poverty. This study used control variables such as human capital stock (proxied by enrollment: primary and secondary), population density, physical isolation index, country size, land locked-ness and natural openness index to assess the independent link between institutions, income and poverty.

The first two panels of Table A-10 and A-11 shows that institutions and trade openness are instrumented for by control variables to exploit exogenous sources of variation. As depicted in the tables, the instruments used for institutions are human capital stock (primary school enrollment), trade openness and population density. The results show that, except in one case (voice & accountability), human capital stock fails to explain a significant amount of the cross country variation in institutions, whereas trade openness explains the variation in institutions in almost all cases with a strongly significant coefficient at the one percent level. Population density has a significant effect in explaining cross country variations in institutions only in two cases (voice and accountability and political stability). In this specification, the human capital index and population density appeared to be weak instruments, however trade openness exerts a much stronger influence on institutions and the finding is consistent with the existing literature (Rodrik *et. al.*, 2004, Easterly and Lavine, 2003).

In the second panels of Table A-10 and A-11, trade openness is instrumented by country size (market size), landlocked-ness, institutional indexes and the Frankel and Romer (1999) natural openness index. In all cases, country size and landlocked-ness fail to explain the cross country variation in openness. However, each of the institutional quality indicators exert a statistically significant impact on openness. This result confirms the two way relationship of trade openness and institutions. The result is also consistent with the findings of Rodrik *et. al.* (2004). According to their argument, improvements in institutional quality make countries more attractive to trading partners, and also have direct effects on growth. Frankel and Romer (1999) define natural openness as trade built up from an equation predicting bilateral trade with other countries. They developed this measure based on a purely geographic approach to handle the problem of endogeneity. Natural openness for the home country is the predicted trade share summing up all predicted bilateral trade with all potential trading partners. The natural openness index also explains the variations in trade openness in most of the cases (See Table A-10 and A-11).

In an alternative specification, Table A-12 and A-13, trade openness is instrumented by physical isolation index, landlocked-ness, institutions and natural openness index.¹⁵ The institutional index is also instrumented by human capital stock (proxied by secondary school enrollment), trade openness and population density. According to this alternative experiment, the geography components as well as the institutional variables influence trade openness significantly at 5% level. The instruments are correctly signed as expected in all the institutional variants. This is the preferred specification of the study and the overall fit

¹⁵ Concerning openness and physical isolation, it is argued that isolation may not only restrict foreign trade, but also constrain development in other ways. (eg. fragmented market, absence of property rights, limited exposure to economic and other changes taking place elsewhere, Gaiha and Imah (2005).

of the model is also good as compared with the other specification in Table A-10 and A-11 (see R^2 in all Tables).

The first panel of Table A-12 and A-13 show that the geography component and human capital stock significantly explain the cross country variations in institutions. The result holds for a range of specifications. In all cases, the control variables are correctly signed and pose statistically large impact on institutions. These findings are consistent with the institutions hypothesis, which stresses that geography influences the formation of long lasting institutions that shape economic development (Acemoglu *et. al.* 2001, Easterly and Levine, 2003). Alternatively, tropical endowment represents an inhospitable disease environment for colonialists, which may foster “extractive” institutions according to the institutions hypothesis of Acemoglu *et. al.* (2001). It is also emphasized by Engerman and Sokoloff (1994) that endowments influence economic development through their impact on institutional development. Except in a few cases, trade openness appeared to be insignificant and wrongly signed (negative) in explaining institutions. In this case, the explanatory power of human capital stock is improved. Glaeser *et. al.* (2004) confirm that initial level of schooling is a strong predictor of improving institutional outcomes even if it has a first order effect on growth. This is also consistent with Lipset's (1960) view that high human capital leads to institutional improvements. While historical and geographical factors have shaped institutional evolution, an alternative formulation points to the importance of human capital in influencing institutional quality, which in turn has a positive impact on income. However, there could be a possibility of reverse causality. In particular, Glaeser *et. al.* (2004) argue that human capital has a direct first hand effect on

income and a secondary effect on institutions. The latter in turn could feedback into higher income. Kaufmann and Kraay (2002), however, pointed out that the effect of income on institutions is relatively weak.

Taking these effects in to account, panel 3 of Tables A-10 to A-13 shows that the exogenous component of the institutions index significantly explains income given other things, which is consistent with the institutions hypothesis (Acemoglu *et. al.* 2001). The institutional index is significant in the income equation at the one percent level except in one regression where political stability is used as a proxy for institutions. In this case, it is significant only at the ten percent level. The results are strongly robust to alternative control variables of human capital stock i.e. secondary school enrollment. Consistent with existing literature discussed in Section 2, there is a strong causal effect running from institutions to per capita income. Furthermore, the instrumental variables are valid and they are highly correlated with the endogenous regressors, as illustrated by the probability values of the instruments validity test in Table A-8. The Over Identification Restriction test does not reject the hypothesis that the instruments can be excluded from the second stage regression. Thus all the instruments are found to be suitable, (for further information see Table A-8 and A-9).

Likewise in the analysis, the relative importance of the various measures representing the broad sense of institutions is also observed. As noted earlier, the variable institution is the principal component composed of voice and accountability, political stability, government effectiveness, regulatory quality, the rule of law, control of corruption and the composite

measure of Kaufman *et. al.* (1999). The first two components (voice and accountability and political stability) are categorized as representing the political institutions whereas, the other measures represent the economic institutions. As is clearly seen in all tables, regardless of the controls used, institutions are strongly significant at 1% level except in two cases in Table A-10 and A-11 (10% level), with a robust positive sign in income specification (equation 1). While observing the effects individually, the third panel of all tables (Table A-10 to A-13) indicates that institutional factors represented by government effectiveness, regulatory quality, the rule of law, and control of corruption have an economically larger impact as compared with the other two measures. On the other hand, measures representing the political institutions (such as voice and accountability and political stability) are significant across specifications but the relative economic importance is low as compared with the other variants. This would be consistent with recent work that has stressed the importance of good governance as distinct from political freedom being critical for driving economic growth (Glaeser *et. al.*, 2004).

In all alternative specifications, the log of lagged agricultural per capita income explains the log of per capita income in a statistically significant manner and has an economically larger impact. The result is in line with the proposition that agriculture is vital to the growth process in developing countries.

In the income equation, the geography component is represented by latitude, a measure of distance from equator. Latitude equals the absolute value of latitude of a country. Countries that are closer to the equator will tend to have a more tropical climate. Tropical

endowments may directly hinder production (Easterly and Levine, 2003). As a robustness check, latitude is replaced by the proportion of land area in the tropics as a measure of geography. Except in one case (government effectiveness), there is concrete evidence in favor of the direct effect of geography. There is statistically significant and modest influence of geography on cross country variations in income. The results confirm the geography proposition, which subsumes the direct effect of geography on income (Sachs & Warner, 1995 and Easterly & Levine, 2003). However, in an alternative estimation, geography represented by the proportion of land area in tropics appears to be insignificant in all institutional variants. Estimation results not reported.

The last component of the income equation is trade openness. After controlling for endogeneity of openness, it does not have any direct explanatory power in the income equation. In most cases, it appears with wrong (negative) sign. The result does not support the openness hypothesis. This is consistent with studies that take account of the dependence of openness on institutions. These studies confirm a weak causal effect of openness on income (Rodrik *et. al.*, 2004). As a robustness check, trade is instrumented with an alternative control variable as indicated in Table A-12 and A-13. However, the sign, size as well as the significance of the openness coefficient in income equation is not improved (See Tables A-12 and A-13).

Baliamoune and Ndikumana (2007) indicate that institutions have a robust and positive impact on growth. More importantly, institutions play an important role in the growth effectiveness of trade openness. They found out that the effect of institutions are non-

monotonic and exhibit a U-shape pattern: at low levels of trade openness, the joint effect of institutions and trade liberalization on growth is negative. As trade openness reaches higher levels, better institutions appear to enhance the growth effects of openness. The evidence in this study supports the view that one of the causes for the limited growth effects of trade openness may be the weakness of institutions. The empirical results imply that institutions have an important influence on the effectiveness of trade policy (assuming that trade policy is strongly correlated with the volume of trade). This is also consistent with the findings from empirical studies that conclude that institutions are crucial for the success of economic reforms in developing countries. Dollar and Kraay (2003) also confirm that good institutions are critical for the ability of a country to generate long-run growth gains from trade liberalization. According to Balamoune and Ndikumana (2007) the weak growth benefits from trade liberalization in African countries may be due to inefficient institutions. Therefore, it appears that the broader institutional environment is key to the transmission of trade openness and trade expansion to growth. This shows that the prevalence of weak institutions in Sub-Saharan African countries may be partially responsible for the observed weak explanatory power of trade openness in income equation.

In the last panel of Tables A-10 to A-13, the poverty equation is estimated after controlling for endogeneity of institutions and Gini coefficients of income distribution. In these regressions (Table A-10 and A-11), the income distribution is instrumented by its respective lagged values (t-1, t-2 and t-3 values). This is mainly due to absence of data on human capital inequality and land inequality measures, which are the possible instruments to exploit exogenous source of variations. In all circumstances, only the t-2 period of

lagged Gini coefficient is significant. Accordingly, in this regression the log of per capita income significantly explains the cross country variations in proportion of poverty (log of head count index and the log of poverty gap). It has a statistically significant and economically larger impact on poverty at one percent level. The income inequality measure exerts the usual effect on poverty as expected. It has a statistically significant and larger influence in explaining cross country variations on poverty positively, it is significant at five percent level. Alternatively, the Gini coefficient is assumed to be exogenous in Table A-12 and A-13, but produces consistent result with the former findings in Table A-10 and A-11.

The institutional measures are found to be insignificant in the poverty equation. In this regression, per capita income and income Gini show the expected result. The changing of head count index with poverty gap almost produces similar result except minor improvements in the coefficients of inequality and income (please see Tables A-10 to A-13). A notable result and one that is very different from the income regressions above is that the poverty regressions mostly fail to produce significant estimates for the institutional variable. However, it should be mentioned that the sign of the institutional variable in some cases is negative; indicating that better institutions have been associated with lower poverty levels.

Several studies, for instance Chong and Calderon (2000) and Kaufmann *et. al.* (1999) argue that an improvement in institutions leads to a reduction in poverty in a statistically significant fashion. They confirm the direct effect of institutions on poverty. In this study,

however, the explanatory power of each institutional quality measures is very low and insignificant. One possible reason can be perhaps institutions exert their effect on poverty through other channels. An obvious channel is income. As indicated in panel 3 of all Tables, institutions exert a powerful influence on income. Thus, after controlling for institutions and other determinants of income, the log of per capita income strongly explains the cross country variations in poverty (head count index and poverty gap measure). The result is in line with the findings of Kaufmann *et. al.* (1999) and Ali (2005) that institutions are important determinant of income.

According to Ali (2001), Sub-Saharan Africa is characterized by the prevalence of rural poverty, thus the findings that certain measures of institutions are not significant explanatory factors of poverty can be supported by this finding. In line with this, Chong and Calderon (2000) noted that less developed countries tend to have more centralized governments; their reach to the rural areas is relatively weak as compared to that of the urban areas. Hence, the usual macro level institutional measures like rule of law may not be the actual order in the poorer areas, as it is known, indigenous and hence, possibly different implicit rules of law patterns may also be in function. This is not to assert that these macro level institutions are not important for the poor.

Chapter 5

5.1 Conclusion and Recommendation

This study seeks to provide evidence whether institutions play an important role in poverty reduction in sub-Saharan Africa. It addresses the question through panel econometrics methods and provides a perspective and review of the relationship between institutions, income and poverty. The analysis relates to the situation in Sub-Saharan African countries, where institutions are weak and seem to have not only contributed to poor growth performance but also to acute poverty. While institutions have been shown to have a direct impact on economic performance (income), their direct impact on poverty is found to be weak. Since institutional improvements evolve over time in a complex ways, it requires extensive experiments to understand their ultimate effect. From the foregoing analysis, certain observations are made: one is that institutional quality indicators influence poverty in most of the cases through income and not directly except in a few cases. The other important lesson learnt is that institutional measures that proxy economic institutions are fundamental in explaining cross country variations in income. They impose an economically large impact on income, in other words, improvement of those institutional quality indicators, for instance improvements in quality of bureaucracy and reduction in the risk of expropriation may reduce uncertainty and can also be linked with poverty reduction by more efficient and speedily allocation of government resources. This provides an impetus to shift the center of attention toward the improvement of these institutions to promote growth process and benefit the poor in the region.

A moderate increase in income in combination with reduction of income inequality will have a substantial poverty reduction impact. Even modest improvements in selected indicators of institutional quality (e.g. rule of law, control of corruption, government effectiveness) will have a substantial effect on poverty through higher incomes. While historical and geographical factors shape institutional quality, human capital independently has a positive effect on it. There is also clear evidence that agriculture is a vital component that explains income in the region. Trade openness does not have an independent effect on income, and geography has a moderate direct influence on income.

While the importance of institutions is established, it must not be overlooked that measurement of institutions is far from straightforward. Moreover, while institutional evolution itself depends on various factors, and some factors were identified in the preceding analysis, it is imperative to better understand, the mechanisms through which incremental institutional change is triggered. As mentioned in previous sections, the importance of institutions rests on an aspect of complex causal links between institutions, income and poverty. If growth itself causes changes in institutions, and these effects are significant, the primacy of institutions may have to be reassessed.

Sub Saharan Africa is characterized by weak institutions. These weak institutions have failed to effect the development process in a sense of sustaining growth and reduce poverty. Moreover, the analysis insights that the institutional quality indicators that are related with the economic institutions (government effectiveness, regulatory quality, rule of law and control of corruption) have a stronger impact on income thereby on poverty. There is also

clear evidence that the political institutions (voice and accountability and political stability) are vital in the growth process, however, based on the relative importance, priorities should be given in the region to the former. Indeed, the evidence here seems to suggest that the components of institutions that stimulate investment, resource allocation and efficiency are more relevant for growth and poverty reduction than the nature of the political system in the region. Taking into account this and the historical roots of current institutions, perhaps the most important institutions to be built or to be strengthened include rule of law (property right), regulatory institutions, economic management institutions, and so on.

To conclude, for poverty reduction in sub-Saharan Africa, not only growth acceleration is required but also the institutional framework that could sustain the growth impact to poverty and cushions inequality are vital, since there is a need to ensure that the poor benefit from the growth process, especially in the rural areas. As noted earlier, the institutional measures that represent the broad notion of institutions are not likely to have a direct impact on poverty reduction and their most obvious influence is through income via the growth process. Thus, in view of the fact that Sub-Saharan Africa is dominated by rural poverty, there is a need to further investigate the nature and pattern of institutions that are relevant to the rural sector.

Table-A-1: Correlations of Measures of Institutions with Other Covariates

Description of variables	Log GNP per capita (2000)	Log per capita agri. GDP (2000)	Log of Gini coefficient	Log of head count index	Control of corruption	Rule of law	Regulatory quality	Government effectiveness	Political stability	Voice and accountability	Trade openness
Log per capita agri. GDP (2000)	0.4072										
Log of Gini coefficient	0.5562	0.1889									
Log of head count index	-0.5441	-0.2033	-0.0050								
Control of corruption	0.6231	0.0710	0.3682	-0.4273							
Rule of law	0.6855	0.1902	0.4181	-0.3787	0.7798						
Regulatory quality	0.5242	0.1890	0.3507	-0.2258	0.4845	0.6047					
Government effectiveness	0.6580	0.1433	0.2892	-0.4314	0.7287	0.8345	0.6549				
Political stability	0.4155	0.1309	0.3192	-0.1063	0.5316	0.5631	0.5304	0.5153			
Voice and accountability	0.5231	0.0860	0.3896	-0.1593	0.5977	0.6141	0.6685	0.6820	0.6723		
Trade openness (2000)	0.4814	0.1862	0.4161	-0.2019	0.3608	0.4187	0.2392	0.3175	0.4468	0.1969	
Ltitude	0.5758	0.1678	0.4567	-0.1469	0.4415	0.4157	0.3179	0.3984	0.282	0.4214	0.3834

Table-A-2: Correlation measures of Institutions, Geography(some indicators), Human capital stock and Openness

	Voice and Accountability	Political stability	Government effectiveness	Regulatory quality	Rule of law	Control of corruption	Latitude	Percentage of land area under tropics	Percentage of population under tropics	Typical pop. Density experienced	Enrollment primary school
Political stability	0.6531										
Government effectiveness	0.7409	0.6290									
Regulatory quality	0.6730	0.6048	0.7854								
Rule of law	0.7586	0.7239	0.8516	0.7639							
Control of corruption	0.6354	0.6072	0.8124	0.6784	0.8545						
Latitude	0.3324	0.2945	0.3931	0.2975	0.4263	0.4354					
Percentage of land area under tropics	-0.2949	-0.3629	-0.3919	-0.3291	-0.4208	-0.5114	0.6953				
Percentage of population under tropics	-0.2590	-0.3226	-0.3370	-0.2945	-0.3417	-0.4608	0.6892	0.9616			
Typical pop. Density experienced	-0.3012	-0.6205	-0.2330	-0.2957	-0.3889	-0.3489	0.0963	0.1789	0.1121		
Enrollment primary school	0.0684	-0.0093	0.2224	0.1264	0.1026	0.1342	-0.5516	-0.3309	-0.3119	0.2334	
Enrollment secondary school	0.5703	0.4373	0.6869	0.4829	0.6658	0.6073	-0.6122	-0.5048	-0.4438	0.0077	0.3797

Table –A-3: Skewness/Kurtosis tests for Normality

Variable	Pr(Skewness)	Pr(Kurtosis)	adjusted chi2(2)	Prob>chi2
Log of per capita GNP	0.000	0.649	28.14	0.0000
Log of lagged per capita agri. GDP	0.000	0.189	14.25	0.0008
Trade openness	0.000	0.008	39.57	0.0000
Voice & accountability	0.304	0.000	16.04	0.0003
Latitude	0.180	0.000	-	0.0000
Country size	0.092	0.000	-	0.0000
Land locked-ness	0.623	-	-	-
Human capital stock	0.425	0.387	1.40	0.4959
Natural openness	0.000	0.000	68.06	0.0000
Experienced pop. Density	0.000	0.000	48.61	0.0000
Log of head count index	0.000	0.859	13.63	0.0011
Log of poverty gap	0.001	0.913	9.72	0.0078
Log of Gini coefficient of income	0.183	0.390	2.54	0.2805
Log of lagged Gini coefficient*	0.189	0.361	2.59	0.2739
Log of lagged Gini coefficient**	0.189	0.361	2.59	0.2739

Ho: Normality

* refers to one period lag of the variable.

**refers to two period lag of the variable.

The test reject the null hypothesis of normality (at 95 % significance level) in some cases such as trade openness, institutional index, and income distribution measures, however it fails to reject in some cases. Thus, it is not a big sacrifice to assume normality as a whole in the observations.

Table-A-4 Hausman (1978) test for endogeneity of openness and institutions on income

Coefficients				
	<u>(b)Consistent</u>	<u>(B)Efficient</u>	<u>(b-B)Difference</u>	<u>S.E.(V(b)-V(B))</u>
Institutions	.7644722	.6774922	.08698	.1491352
Openness	-.0450882	.4293783	-.4744665	.1038615

H₀: OLS is consistent and efficient

The instruments used in the instrumental variable estimation are human capital stock, population density, physical isolation index, land locked-ness, and natural openness index.

b = consistent under H₀ and H_a; obtained from ivreg

B = inconsistent under H_a, efficient under H₀; obtained from regress

Test: H₀: difference in coefficients not systematic

$$\text{Chi}^2(2) = (b-B)'[(V_b - V_B)^{-1}](b-B)$$

$$= 54.57$$

$$\text{Prob chi}^2 = 0.0000$$

The null is rejected at 95% significance level, that the test confirms the presence of endogeneity. In fact Hausman test is mainly meant for specification test, however, it also serves as endogeneity test. If the test reject the null, then OLS is biased and inefficient due to endogeneity.

Table –A-5. Alternative test for endogeneity of Institutions and Openness

Residual model-1			Residual model-2		
Dependent variable			Dependent variable		
Trade openness	Coefficient	t-value	Institutions	Coefficient	t-value
Institutions	0.1209	4.41	Trade openness	-0.3201	-1.81*
Physical isolation index	-0.0005	-7.82	Human capital stock	0.0195	7.36
Land locked-ness	0.1265	2.86*	Experienced pop. Density	-0.0018	-4.75
Natural openness	0.0146	9.17			

Note: * indicate it is significant at 1% level.

These are the auxiliary regressions used to predict the respective residuals, to be used in the second stage.

Full model (Original model)		
Dependent variable		
Log of income per capita	Coefficient	t-value
Log of lagged per capita agri. GDP	0.6660	5.98
Trade openness	0.1728	0.89
Institutions	0.1043	1.36
Latitude	-0.0177	-5.47
Openness residual predicted	-0.1510***	-1.63
Institutions residual predicted	1.182	8.00

Note: *** indicate it is significant at 10% level.

The residual sum of square from model-1= 11.46, the residual sum of square from model-2= 28.81. The sum of the two provides the residual sum of square from the restricted model = 40.27. The residual sum of square from unrestricted model (original model) =13.46

$$F = \frac{(RRSS - URSS) / (N - 1)}{URSS / (NT - N - K)} \approx F_{N-1, N(T-1)-K} = \underline{\underline{27.25}}$$

Accordingly it provides F-statistics of 27.25, which is above the critical value of 1.46 for (28,255) degrees of freedom. This enables to reject the null hypothesis that the predicted residuals are jointly equal to zero, which confirms the endogeneity of both factors.

Table –A-6 Hausman Specification test

Log of per Capita GNP	<u>Fixed effect estimation</u>			<u>Random effect estimation</u>		
	Coefficients	z	P> z	Coefficient	z	P> z
Log of lagged per capita.						
Agricultural GDP	.0322942	0.61	0.543	.0759553	1.38	0.166
Institutional index	.1048808	1.82	0.171	.145869	2.53	0.011
Trade openness	.1594807	0.79	0.431	.4083227	2.29	0.022
Latitude	-	-	-	-.0303228	-4.18	0.000

Log of per Capita GNP	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fixed	(B) Random		
Log of lagged per capita.				
Agricultural GDP	.0322942	.0759553	-.043661	-
Trade openness	.1594807	.4083227	-.2488421	.0953874
Institutional index	.1048808	.145869	-.0409882	.0043539

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

$$\text{Chi2}(3) = (b-B)'[(V_b-V_B)^{-1}](b-B)$$

$$= \mathbf{106.84}$$

$$\text{Prob}>\text{chi2} = 0.0000$$

Table –A-7 Hausman Specification test

Log of head Count Index	<u>Fixed effect estimation</u>			<u>Random effect estimation</u>		
	Coefficients	z	P> z	Coefficient	z	P> z
Log of Gini coefficient	1.374667	1.82	0.069	-0.5126185	-5.56	0.000
Institutional index	-0.0323836	-0.39	0.700	1.155265	3.15	0.002
Log of per capita income	-0.1918087	-1.14	0.252	0.094145	1.38	0.169

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) Fixed	(B) Random		
Log of Gini coefficient	1.374667	1.155265	.2194021	.6611069
Institutional index	-0.0323836	0.094145	-.1265286	.0488124
Log of per capita income	-0.1918087	-0.5126185	.3208098	.1398861

b = consistent under Ho and Ha; obtained from xtivreg

B = inconsistent under Ha, efficient under Ho; obtained from xtivreg

Test: Ho: difference in coefficients not systematic

$\text{Chi}^2(3) = (b-B)'[(V_b-V_B)^{-1}](b-B)$

= 7.34

Prob>chi2 = 0.0617

The two structural equations, equation one and four is used to test Hausman (1978). According to Table 7, the test rejects the random effect model, however as we observe the t-values and the probability values, all the factors in fixed effect model is insignificant whereas in random effect model, they are better off and significant. This support random effect model is still efficient. The second test (Table 8) however, fails to reject random effect model with the critical Chi2 value of 7.81 with three degrees of freedom, justifying random effect model is still efficient and consistent.

Table –A-8 Bound *et. al.* (1995) test for validity of instruments

Trade openness	Coefficient.	P> t	Institutional index	coefficient	P> t
Land locked-ness	.1075	0.007	Human capital stock	0.0162	0.000
Natural openness	.0125	0.000	Population density	-0.0014	0.000
Physical isolation index	-.0005	0.000			

H₀: Instruments are valid

These are the first stage regression in Bound *et. al* (1995) test. The probability values indicate that the instruments are correlated with the endogenous regressors. The partial R^2 is determined using the following formula,

$$(RSS_{Z_2} - RSS_Z)/TSS$$

[47.556 -15.877]/ 100.745

[47.556 – 12.208]/100.745

0.314

0.351

The above figures are the respective partial R^2 , In both cases the partial R^2 is moderately larger. Thus instruments in conclusion, are positively correlated with endogenous regressors.

Table –A-9 Sargan (1958) test for relevance of instruments

This is the second stage regression of Sargan (1958) test to justify that the instruments are uncorrelated with the error.

Residual from IV regression	Coefficient.	P> z
Land locked-ness	-0.03690	0.881
Natural openness	0.00758	0.488
Country size	0.00005	0.862
Population density	-0.00058	0.456
Primary school enrollment	0.00048	0.656
Secondary school enrollment	0.00254	0.221
Physical isolation index	-0.00049	0.145

H₀: all instruments are orthogonal to the error.

The test statistic is nR^2 ,=[0.0976*103]= 10.05. The critical chi-square value for 5 over identification restriction is 11.07 at five percent level. Thus the test does not reject the null hypothesis of instruments exogeneity. This is also supported by high probability values of the respective instruments that justifies the instruments are uncorrelated with the predicted residual.

Table -A-10. The Error Component System Estimation (EC3SLS) of Institutional variables, Trade openness, per capita income and Head Count index (Poverty)

Dependent variables	Explanatory variables	Institutional variable variants						
		Voice & accountability	Political stability	Government effectiveness	Regulatory quality	Rule of law	Control of corruption	Institutional index
Institutional variables								
	Human capital stock	0.006*** (1.820)	0.004 (1.390)	0.001 (0.490)	0.002 (0.140)	0.000 (0.260)	0.001 (0.400)	0.002 (1.030)
	Trade openness	0.005 (0.010)	1.19* (3.150)	0.802* (2.680)	0.723 (2.610)	1.038 (3.670)	0.810* (2.810)	0.727* (2.630)
	Population density experienced	-0.001** (-2.38)	-0.002* (-2.85)	-0.0001 (-0.44)	0.000 (-0.06)	0.000 (-0.3)	-0.0001 (-0.56)	-0.0004 (-1.32)
	No. of observations	116	116	116	116	116	116	116
	Adjusted R2	0.1296	0.3726	0.1090	0.0134	0.1525	0.1141	0.1985
Trade openness								
	Country size	0.000 (-1.51)	0.000 (-.80)	0.000 (-1.04)	0.000 (-1.62)	0.000 (-1.64)	0.000 (-1.38)	0.000 (-1.39)
	Land locked-ness	0.023 (-0.35)	-0.053 (-1.06)	-0.014 (-0.32)	-0.006 (-0.11)	-0.031 (-0.86)	-0.063 (-1.60)	-0.029 (-0.61)
	Institutional variable	0.439 (5.270)	0.348 (5.730)	0.749 (8.36)	0.995 (6.67)	0.747 (8.58)	0.828 (8.57)	0.69 (7.44)
	Natural openness.	0.015 (4.710)	0.006** (2.070)	0.008 (2.95)	0.004 (1.32)	0.003 (1.32)	0.004*** (1.86)	0.007** (2.39)
	No. of observations	116	116	116	116	116	116	116
	Adjusted R2	0.1496	0.277	0.3952	0.7138	0.3079	0.8664	0.1442
Log of per capita GNP								
	Log of lagged per capita Agricultural GDP	1.131 (7.360)	1.2 (6.970)	0.409*** (1.780)	0.913 (5.130)	1.027 (6.410)	1.127 (7.320)	1.107 (7.210)
	Trade openness	0.387 (1.190)	-0.113 (-.25)	0.187 (0.460)	-0.405 (0.399)	-0.822** (-2.03)	-0.593 (-1.37)	0.004 (0.010)
	Institutional variable	0.509 (3.870)	0.327*** (1.810)	2.5 (4.880)	1.77 (5.640)	1.616 (5.330)	1.658 (3.730)	0.911 (3.630)
	Latitude	0.023 (-4.75)	0.028 (-5.45)	0.005 (0.480)	0.023 (-4.05)	0.018 (-3.25)	0.015** (-2.14)	0.019 (-3.56)
	No. of observations	116	116	116	116	116	116	116
	Adjusted R2	0.7614	0.6898	0.0950	0.2005	0.4876	0.4352	0.7407
Log of head count index								
	Log of per capita GNP	-0.56 (-4.39)	-0.488 (-3.92)	-0.837* (-2.79)	-0.643 (-3.63)	-0.543* (-3.10)	-0.593 (-3.80)	-0.57 (-3.81)
	Log of Gini coefficient	1.09* (2.620)	1.2* (2.870)	1.32** (2.94)	1.18 (2.820)	1.337 (3.250)	1.165* (2.800)	1.19 (2.94)
	Institutional variable	0.537* (2.800)	0.15 (0.830)	1.07*** (1.880)	0.84 (1.710)	0.224 (0.560)	0.585 (1.510)	0.493 (1.530)
	No. of observations	116	116	116	116	116	116	116
	Adjusted R2	0.1544	0.1613	0.0141	0.0147	0.3204	0.0961	0.2043

Note that the results shown in the parenthesis are the t-value and the model includes the constant term but not reported. *, ** and *** denotes significance at 1%, 5% and 10% level
Note: also in all the specifications the Gini coefficient for income is instrumented by its respective lagged period of exogenous term. In all cases only the second period lag significantly explained the cross country variation in income inequality. The estimation is not reported.

Table -A-11. The Error Component System Estimation (EC3SLS) of Institutional variables, Trade openness, per capita income and Poverty Gap index (Poverty)

Dependent variables	Explanatory variables	Institutional variable variants					
		Voice & accountability	Political stability	Government effectiveness	Regulatory quality	Rule of law	Control of corruption
Institutional variables							
	Human capital stock	0.006*** (1.820)	0.004 (1.45)	0.001 (0.49)	0.0003 (0.19)	0.000 (0.31)	0.001 (0.44)
	Trade openness	0.018 (0.040)	1.15* (3.08)	0.81* (2.70)	0.709 (2.59)	1.017 (3.61)	0.794* (2.78)
	Population density experienced	-0.001** (-2.43)	-0.002* (-2.96)	-0.0001 (-0.46)	0.000 (-0.13)	0.000 (-0.36)	-0.0001 (-0.61)
	No. of observations	116	116	116	116	116	116
	Adjusted R2	0.1314	0.3770	0.1072	0.0177	0.1583	0.1175
Trade openness							
	Country size	0.000 (-1.51)	0.000 (-0.81)	0.000 (-1.04)	0.000 (-1.60)	0.000 (-1.64)	0.000 (-1.39)
	Land locked-ness	0.029 (-0.45)	-0.059 (-1.16)	-0.016 (-0.38)	-0.009 (-0.18)	-0.034 (-0.92)	-0.066*** (-1.68)
	Institutional variable	0.435 (5.230)	0.345 (5.68)	0.743 (8.33)	0.99 (6.67)	0.748 (8.61)	0.829 (8.61)
	Natural openness.	0.015 (4.730)	0.006** (2.19)	0.008* (2.97)	0.004 (1.39)	0.003 (1.38)	0.004*** (1.83)
	No. of observations	116	116	116	116	116	116
	Adjusted R2	0.155	0.2838	0.387	0.6922	0.3105	0.8694
Log of per capita GNP							
	Log of lagged per capita Agricultural GDP	1.133 (7.380)	1.2 (7.00)	0.427*** (1.78)	0.915 (5.14)	1.03 (6.43)	1.129 (7.33)
	Trade openness	0.385 (1.180)	-0.107 (-0.23)	0.122 (0.29)	-0.406 (1.02)	-0.82** (-2.03)	-0.604 (-1.39)
	Institutional variable	0.509 (3.870)	0.328*** (1.81)	2.50 (4.80)	1.77 (5.64)	1.62 (5.34)	1.667 (3.75)
	Latitude	0.023 (-4.75)	0.028 (-5.41)	0.004 (0.41)	0.022 (-4.06)	0.018 (-3.24)	0.015** (-2.14)
	No. of observations	116	116	116	116	116	116
	Adjusted R2	0.7615	0.6899	0.1054	0.2012	0.4862	0.4297
Log of Poverty Gap index							
	Log of per capita GNP	-0.92 (-4.97)	-0.835 (-4.60)	-1.18* (-2.72)	-1.06 (-4.12)	-0.908* (-3.56)	-0.974 (-4.31)
	Log of Gini coefficient	2.56 (4.20)	2.55 (4.17)	2.77 (4.24)	2.58 (4.22)	2.8 (4.68)	2.57 (4.27)
	Institutional variable	0.718** (2.56)	0.313 (1.22)	1.21 (1.31)	1.38 (1.92)	0.425 (0.73)	0.923 (1.65)
	No. of observations	116	116	116	116	116	116
	Adjusted R2	0.2632	0.3599	0.2084	0.005	0.3728	0.1564

Note that the results shown in the parenthesis are the t-value and the model includes the constant term but not reported. *,**and *** denotes significance at 1%, 5% and 10% level
Note: also in all the specifications the Gini coefficient for income is instrumented by its respective lagged period of exogenous term. In all cases only the second period lag significantly explained the cross country variation in income inequality. The estimation is not reported.

Table -A-12. The Error Component System Estimation (EC3SLS) of Institutional variables, Trade openness, per capita income and Head Count index

This is an alternative estimation by using secondary school enrollment proxy for human capital stock and physical isolation index for openness.

Dependent variables	Explanatory variables	Institutional variable variants					
		Voice & accountability	Political stability	Government effectiveness	Regulatory quality	Rule of law	Control of corruption
Institutional variables							
	Human capital stock	0.026 (8.13)	0.014 (5.04)	0.016 (7.38)	0.014 (5.04)	0.015 (6.18)	0.015 (6.18)
	Trade openness	-0.834* (-3.28)	0.605** (2.45)	-0.053 (-0.32)	0.605** (2.15)	0.308*** (1.61)	0.308*** (1.61)
	Population density experienced	-0.002 (-4.75)	-0.002 (-4.05)	-0.001 (-4.03)	-0.001 (-4.07)	-0.001 (-3.66)	-0.001 (-3.66)
	No. of observations	116	116	116	116	116	116
	Adjusted R ²	0.416	0.485	0.500	0.556	0.556	0.463
Trade openness							
	Physical isolation index	-0.001 (-5.31)	-0.0004 (-4.87)	-0.0005 (-5.4)	-0.0004 (-4.87)	-0.001 (-5.11)	-0.0005 (-5.15)
	Land locked-ness	0.129** (2.10)	0.119** (2.24)	0.148** (2.40)	0.118** (2.24)	0.136** (2.45)	0.155 (2.69)
	Institutional variable	0.179 (3.59)	0.264 (4.99)	0.296 (3.88)	2.64 (4.99)	1.83 (9.15)	0.32 (4.54)
	Natural openness.	0.017 (7.11)	0.009 (4.26)	0.013 (5.55)	0.09 (4.26)	0.01 (4.65)	0.01 (4.66)
	No. of observations	116	116	116	116	116	116
	Adjusted R ²	0.622	0.5766	0.5877	0.5726	0.5726	0.506
Log of per capita GNP							
	Log of lagged per capita Agricultural GDP	0.975 (7.75)	1.08 (6.07)	0.744 (7.13)	1.079 (6.07)	0.769 (6.53)	0.864 (7.02)
	Trade openness	0.256 (1.16)	-1.37* (-3.13)	-0.164 (-0.73)	-1.37* (-3.13)	-0.953 (-3.27)	-0.853* (-2.87)
	Institutional variable	0.929 (9.20)	1.24 (6.13)	1.70 (9.30)	1.24 (6.13)	1.83 (9.15)	1.78 (8.68)
	Latitude	0.019 (-4.81)	0.027 (-5.36)	0.013 (-3.93)	0.026 (-5.36)	0.015 (-4.14)	0.014 (-3.52)
	No. of observations	116	116	116	116	116	116
	Adjusted R ²	0.7165	0.317	0.668	0.495	0.495	0.480
Log of head count index							
	Log of per capita GNP	-0.735 (-6.31)	-0.614 (-5.44)	-0.495** (-2.48)	-0.614 (-5.44)	-0.527 (-3.17)	-0.66 (-4.20)
	Log of Gini coefficient	1.91 (5.32)	1.96 (5.51)	1.86 (5.13)	1.96 (5.51)	1.91 (5.47)	1.88 (5.35)
	Institutional variable	0.046 (0.28)	-0.19 (-1.3)	-0.507 (1.23)	-0.198 (-1.30)	-0.404 (-1.20)	-0.08 (-0.28)
	No. of observations	116	116	116	116	116	116
	Adjusted R ²	0.408	0.3903	0.3214	0.3727	0.3727	0.4145

Note that the results shown in the parenthesis are the t-value and the model includes the constant term but not reported. *, ** and *** denotes significance at 1%, 5% and 10% level.
In this regression the Gini coefficient of income distribution is assumed to be exogenous.

Table -A-13. The Error Component System Estimation (EC3SLS) of Institutional variables, Trade openness, per capita income and Poverty Gap index

This is an alternative estimation by using secondary school enrollment proxy for human capital stock and physical isolation index for openness.

Dependent variables	Explanatory variables	Institutional variable variants					
		Voice & accountability	Political stability	Government effectiveness	Regulatory quality	Rule of law	Control of corruption
Institutional variables							
	Human capital stock	0.026 (8.10)	0.014 (5.15)	0.016 (7.46)	0.014 (5.94)	0.015 (6.99)	0.015 (6.25)
	Trade openness	-0.806 (-3.17)	0.572** (2.31)	-0.051 (-0.32)	-0.044 (-0.22)	0.307*** (1.81)	0.290 (1.52)
	Population density experienced	-0.002 (-4.64)	-0.002 (-4.15)	-0.001 (-3.96)	-0.007 (-2.94)	-0.001 (-3.85)	-0.001 (-3.69)
	No. of observations	116	116	116	116	116	116
	Adjusted R ²	0.419	0.488	0.501	0.322	0.559	0.466
Trade openness							
	Physical isolation index	-0.001 (-5.53)	-0.0005 (-5.13)	-0.0005 (-5.54)	-0.0005 (-5.69)	-0.0004 (-5.35)	-0.0005 (-5.42)
	Land locked-ness	0.124** (2.04)	0.115** (2.2)	0.139** (2.28)	0.147** (2.39)	0.130** (2.36)	0.149* (2.61)
	Institutional variable	0.175 (3.53)	0.259 (4.91)	0.291 (3.81)	0.376 (3.76)	0.321 (4.78)	0.32 (4.49)
	Natural openness.	0.017 (7.10)	0.009 (4.31)	0.013 (5.56)	0.012 (4.98)	0.01 (4.68)	0.01 (4.71)
	No. of observations	116	116	116	116	116	116
	Adjusted R ²	0.622	0.5789	0.5886	0.4856	0.5746	0.5096
Log of per capita GNP							
	Log of lagged per capita Agricultural GDP	0.974 (7.74)	1.07 (6.03)	0.743 (7.12)	0.684 (5.71)	0.766 (6.50)	0.86 (6.98)
	Trade openness	0.253 (1.15)	-1.30* (-2.97)	-0.157 (-0.71)	-0.201 (-0.64)	-0.91 (-3.11)	-0.827* (-2.79)
	Institutional variable	0.933 (9.24)	1.22 (6.01)	1.70 (9.36)	2.049 (6.76)	1.82 (9.07)	1.77 (8.63)
	Latitude	0.019 (-4.78)	0.027 (-5.29)	0.013 (-3.90)	0.014 (-3.62)	0.015 (-4.09)	0.014 (-3.52)
	No. of observations	116	116	116	116	116	116
	Adjusted R ²	0.7152	0.335	0.668	0.258	0.506	0.488
Log of Poverty gap index							
	Log of per capita GNP	-1.105 (-6.59)	-1.025 (-6.31)	-0.677** (-2.48)	-1.069 (-4.54)	-0.857 (-3.59)	-1.076 (-4.73)
	Log of Gini coefficient	3.69 (7.17)	3.71 (7.26)	3.53 (6.81)	1.96 (5.75)	3.64 (7.28)	3.595 (7.20)
	Institutional variable	-0.096 (0.40)	-0.211 (-0.96)	-1.073*** (1.81)	-0.063 (-0.07)	-0.583 (-1.21)	-0.073 (-0.18)
	No. of observations	116	116	116	116	116	116
	Adjusted R ²	0.4677	0.4623	0.346	0.4732	0.4427	0.4759

Note that the results shown in the parenthesis are the t-value and the model includes the constant term but not reported. *,**and *** denotes significance at 1%, 5% and 10% level
In this regression the Gini coefficient of income distribution is assumed to be exogenous.

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Annex 1: Kinal and Lahiri (1993) algorithm

The structural equations of the study are represented as:

$$Y_{jit} = \beta_j X_{jit} + \eta_{ji} + U_{jt} \quad (1)$$

J refers to the no. of equations, $j=1, \dots, M$, $i=1, \dots, N$ (cross-sectional observation) and $t=1, \dots, T$ (time).

An EC3SLS estimator of β is

$$\beta_{EC3SLS} = (x^* P_{z^*} x^*)^{-1} (x^* P_{z^*} y^*) \quad (2)$$

Where $y^* = V^{-1/2} y$, $x^* = V^{-1/2} x$, $z^* = V^{-1/2} z$, $P_{z^*} = z^* (z^{*'} z^*)^{-1} z^{*}$, z is a matrices of instruments, $V = \text{var}(\varepsilon)$ and $\varepsilon = \eta + u$.

Kinal and Lahiri (1993) compute y^* , x^* and ε^* as:

$$W^* = V^{-1/2} W = (I_N \otimes \Delta^{-1}) \begin{bmatrix} w.1 \\ w.2 \\ . \\ . \\ w.n \end{bmatrix} = \begin{bmatrix} \Delta^{-1} w.1 \\ \Delta^{-1} w.2 \\ . \\ . \\ \Delta^{-1} w.N \end{bmatrix} \quad (3)$$

This transformation guarantees that the instruments be uncorrelated with the disturbances in every equations when instruments differs across equations ().

Where $JT = i_T i_T'$, i_T is a column vector of ones,

$$\Delta^{-1} = S_1^{-1} \otimes I_T + \frac{1}{T} (S_2^{-1} - S_1^{-1}) \otimes J_T \quad (4)$$

And S_1 and S_2 are Choleski decomposition satisfying:

$$S_1 S_1' = \sum_u \text{ and } S_2 S_2' = \sum_u + T \sum_u \quad (5)$$

Kinal and Lahiri (1993) has developed a program for () to () that makes estimation of a general simultaneous equation error component model which is computationally easier. First they employ numerically more stable eigenvalue decomposition.

$$V^{-1/2} = I_N \otimes \Sigma^{-1/2} \quad (6)$$

Appendix

Where
$$\Sigma^{-1/2} = \Sigma^{-1/2}_1 \otimes I_T + \frac{1}{T}(\Sigma^{1/2}_2 - \Sigma^{1/2}_1) \otimes J_T \quad (7)$$

And $\Sigma_1^{1/2}$ and $\Sigma_2^{1/2}$ are factorization that satisfies:

$$\Sigma_1^{1/2} \Sigma_1^{1/2} = \Sigma_u \text{ and } \Sigma_2^{1/2} \Sigma_2^{1/2} = \Sigma_u + T \Sigma_\eta \quad (8)$$

The transformed instrument set $Z^* = V^{1/2}Z$ may be obtained by replacing $\Sigma_1^{-1/2}$ and $\Sigma_2^{-1/2}$, respectively, with $\Sigma_1^{1/2}$ and $\Sigma_2^{1/2}$.

The within and between dimensions of the data are weighted by the information obtained in $\Sigma_1^{-1/2}$ and $\Sigma_2^{-1/2}$, respectively. The within dimension of the data is given by:

$$\bar{W}_{.i} = W_{.i} - \bar{W}_{.i} \quad (10)$$

Where the between dimension of the data $\bar{W}_{.i}$, is:

$$\bar{W}_{ji} = J_T W_{ji} / T \quad (11)$$

Given (6) through (11), Kinal and Lahiri (1993) notation that the elements in $W^* = V^{-1/2}W$ are given by:

$$W_{.i} = S_1^{-1} W_{.i} + (S_2^{-1} - S_1^{-1}) \bar{W}_{.i} = S_1^{-1} \tilde{W}_{.i} + S_2^{-1} \bar{W}_{.i} \quad (12)$$

Therefore, incase where there are right hand side variables correlated with the disturbance in an error component model, error component 3SLS estimates of multiple equations can be obtained by applying instrumental variable estimation to the transformed equation (2) using Z^* as an instruments. This transformation process guarantees that the instruments be uncorrelated with the disturbances in every equation, when the instruments differ across equations (Kinal and Lahiri, 1993).

Annex 2: Baltagi (2001) System estimation

Consider the system of identified equations

$$y = Z\delta + u \quad (1)$$

Where $y' = (y_1', \dots, y_M')$, $Z = \text{diag}[Z_j]$, $\delta' = (\delta_1', \dots, \delta_M')$ and $u' = (u_1', \dots, u_M')$ with $Z_j = [Y_j, X_j]$ of dimension $N \times (g_j + k_j)$, for $j=1, \dots, M$. In this case there are g_j included right hand side Y_j and k_j included right hand side X_j . For one way error component model, the disturbance of the j^{th} equation U_j is given by $U_j = Z_{\mu j} \mu_j + V_j$ $j=1, \dots, M$ and $\Omega_{jt} = E(u_j u_j')$ is given by $\Omega_{jt} = \sigma_{\mu j}^2 (I_N \otimes J_T) + \sigma_{vj}^2 (I_N + I_T)$ and $\Omega^{-1/2}$ is given by $= \Sigma_1^{-1/2} \otimes P + \Sigma_v^{-1/2} \otimes Q$. Premultiplying (1) by $(I_M \otimes Q)$ yields

$$\tilde{y} = \tilde{Z}\delta + \tilde{U} \quad (2)$$

The within 3SLS estimator can be obtained by:

$$\tilde{\delta}_{w3SLS} = [\tilde{Z}'(\Sigma_v^{-1} \otimes P_{\tilde{X}})\tilde{Z}]^{-1}[\tilde{Z}'(\Sigma_v^{-1} \otimes P_{\tilde{X}})\tilde{y}] \quad (3)$$

Similarly transforming (1) by $(I_M \otimes P)$ yields

$$\bar{y} = \bar{Z}\delta + \bar{U} \quad (4)$$

The between 3SLS estimator can be estimated by:

$$\bar{\delta}_{b3SLS} = [\bar{Z}'(\Sigma_1^{-1} \otimes P_{\bar{X}})\bar{Z}]^{-1}[\bar{Z}'(\Sigma_1^{-1} \otimes P_{\bar{X}})\bar{y}] \quad (5)$$

The two transformed system is stacked after premultiplying by $(I_M \otimes \bar{X}')$ and $(I_M \otimes \tilde{X}')$ respectively. The resulting estimator of δ is the error component three stage least squares (EC3SLS) given by Baltagi (1981):

$$\hat{\delta}_{EC3SLS} = [\tilde{Z}'(\Sigma_v^{-1} \otimes P_{\tilde{X}})\tilde{Z} + \bar{Z}'(\Sigma_1^{-1} \otimes P_{\bar{X}})\bar{Z}]^{-1} \{ \tilde{Z}'(\Sigma_v^{-1} \otimes P_{\tilde{X}})\tilde{y} + \bar{Z}'(\Sigma_1^{-1} \otimes P_{\bar{X}})\bar{y} \}$$

Note that $\hat{\delta}_{EC3SLS}$ can also be written as a matrix-weighted average of $\hat{\delta}_{w3SLS}$ and $\hat{\delta}_{b3SLS}$ as follows:

$$\hat{\delta}_{EC3SLS} = \hat{\delta}_{w3SLS} + \hat{\delta}_{b3SLS} \quad (6)$$

Appendix

With

$$W_1 = [\tilde{Z}'(\Sigma_v^{-1} \otimes P_{\tilde{X}})\tilde{Z} + \bar{Z}'(\Sigma_l^{-1} \otimes P_{\bar{X}})\bar{Z}]^{-1}[\tilde{Z}'(\Sigma_v^{-1} \otimes P_{\tilde{X}})\tilde{Z}] \quad (7)$$

And

$$W_2 = [\tilde{Z}'(\Sigma_v^{-1} \otimes P_{\tilde{X}})\tilde{Z} + \bar{Z}'(\Sigma_l^{-1} \otimes P_{\bar{X}})\bar{Z}]^{-1}[\bar{Z}'(\Sigma_v^{-1} \otimes P_{\tilde{X}})\bar{Z}] \quad (8)$$

Consistent estimate of Σ_v and Σ_l can be obtained using W2SLS and B2SLS residuals with:

$$\hat{\sigma}_{vjt}^2 = (y_j - Z_j \tilde{\delta}_{j.W2SLS})' Q(y_l - Z_l \tilde{\delta}_{l.W2SLS}) / N(T-1) \quad (9)$$

$$\hat{\sigma}_{vjt}^2 = (y_j - Z_j \hat{\delta}_{j.B2SLS})' Q(y_l - Z_l \hat{\delta}_{l.B2SLS}) / N \quad (10)$$

In applications, it is easy to obtain EC3SLS using standard 3SLS STATA package as:

1. Obtain W2SLS and B2SLS estimates of each structural equations.
2. Compute $\hat{\Sigma}_v$ and $\hat{\Sigma}_l$ as described in (9) and (10).
3. Obtain the Choleski decomposition of $\hat{\Sigma}_v^{-1}$ and $\hat{\Sigma}_l^{-1}$ and use $\hat{\Sigma}_v^{-1/2}$ and $\hat{\Sigma}_l^{-1/2}$ in the transformation process.
4. Apply 3SLS in the transformed system.

Variable name	Definitions	Sources
Log of Per Capita Agricultural GDP (constant 2000 US\$):	Agriculture includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. Calculated as a percentage of GDP divided by population.	<i>WDI 2006.</i>
Per Capita GDP (constant 2000 US\$):	Per Capita GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. Data are in constant 2000 U.S. dollars.	<i>WDI 2006.</i>
GNI per capita, Atlas method	GNI is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad. GNI, calculated in national currency, is usually converted to U.S. dollars at official exchange rates for comparisons across economies.	<i>WDI 2006.</i>
School enrollment, primary (%):	is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.	<i>WDI, 2006</i>
School enrollment, secondary (%):	Secondary education completes the provision of basic education that began at the primary level, and aims at laying the foundations for lifelong learning and human development, by offering more subject- or skill-oriented instruction using more specialized teachers	<i>WDI, 2006</i>
Population	is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship, except for refugees not permanently settled in the country of	<i>WDI 2006.</i>

	asylum, which are generally considered part of the population of their country of origin.	
GINI index:	measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution. A Lorenz curve plots the cumulative percentages of total income received against the cumulative number of recipients, starting with the poorest individual or household. The Gini index measures the area between the Lorenz curve and a hypothetical line of absolute equality, expressed as a percentage of the maximum area under the line. Thus a Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.	Chen and Ravalion (2004).
Poverty headcount ratio at \$1 a day (PPP) (% of population):	the percentage of the population living on less than \$1.08 a day at 1993 international prices. Data showing as 2.0 Signifies a poverty rate of less than 2.0 percent.	World Bank Estimate. Chen and Ravalion (2004).
Poverty gap at \$1 a day (PPP) (%):	the mean shortfall from the poverty line (counting the non poor as having zero shortfall), expressed as a percentage of the poverty line. This measure reflects the depth of poverty as well as its incidence.	World Bank Estimate. Chen and Ravalion (2004).
Country size (Area):	total land area in Km square, calculated in equal area projection. It served as a measure of market size.	www.cid.harvard.edu/economic.htm .
Distance from equator:	Measured by latitude of country centroid. In those countries where the country centroid fell in the ocean, it was moved to within the nearest land boundary.	www.cid.harvard.edu/economic.htm
Distance to coast:	It is a measure of physical isolation and it is mean distance to nearest coastline (km). Distance from ice-free coastline or navigable water calculated in Plate Caree projection.	www.cid.harvard.edu/economic.htm

Glossary: Data Descriptions and Sources

Population density	Typical population density experienced by an individual country (persons/km ²). (5'cell density*5'cell pop/total country pop).	www.cid.harvard.edu/economic.htm
Tropical land area	Percentage of Land area in geographical tropics. Calculated in equal area projection.	www.cid.harvard.edu/economic.htm **
Voice and accountability	the extent to which citizens can choose their government, political rights, civil liberties, and an independent press.	www.worldbank.org/wbi/governance
Political stability	the likelihood that the government will be overthrown by unconstitutional or violent means.	"
Government effectiveness	quality of public service delivery, competence of civil servants, and the degree of politicization of the civil service.	"
Regulatory quality	relative absence of government controls on goods markets, government interference in the banking system, excessive bureaucratic controls on starting new businesses, or excessive regulation of private business and international trade.	"
Rule of law	protection of persons and property against violence or theft, independent and effective judges, contract enforcement.	"
Control of corruption	absence of the use of public power for private gain, corruption. it measures perceptions of corruption	"
Average Institutional index	The simple average of the above six institutional measures	Owen calculation
Trade openness	The ratio of total trade volume (export + import) at constant price to GDP at constant price (USD 2000).	Penn World Data set*

*Center for international comparison of production and price, **University of Pennsylvania**.

** Center for International development, **University of Harvard**.

Simple Scatter Plot relationships of the Key Factors

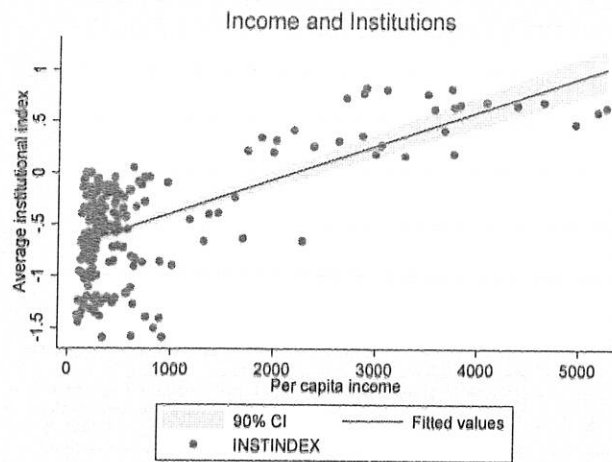


Fig. 2

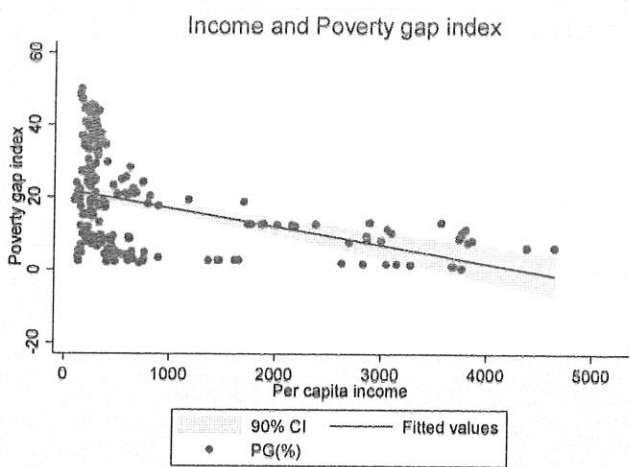


Fig. 3

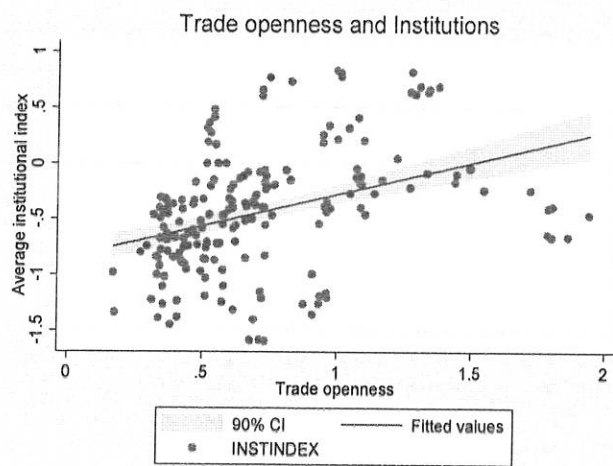


Fig. 4

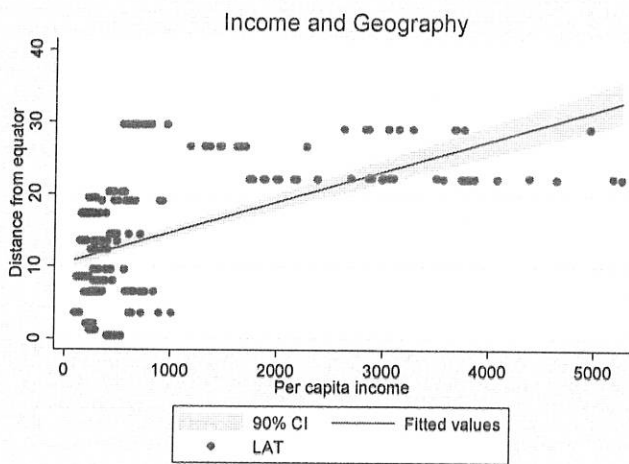


Fig. 5

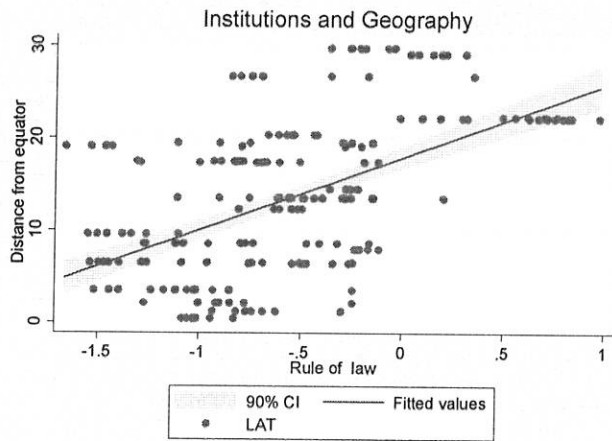


Fig. 6

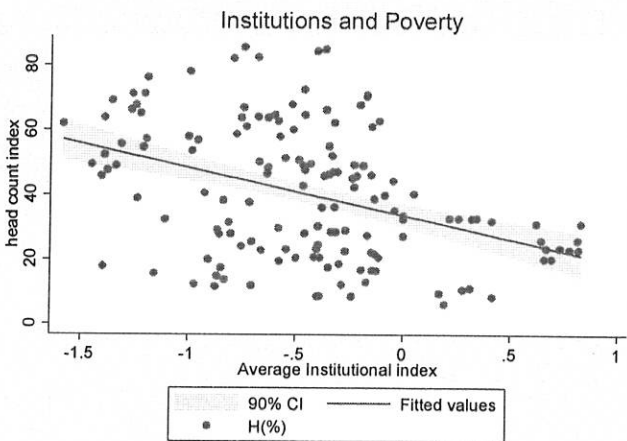


Fig. 7

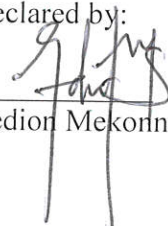
Table A-14. List of Countries in the Sample

Ser. No.	Countries
1	Botswana
2	Burkina Faso
3	Burundi
4	Cameroon
5	Central African R.
6	Cote d'Ivoire
7	Ethiopia
8	Gambia
9	Ghana
10	Kenya
11	Lesotho
12	Madagascar
13	Malawi
14	Mali
15	Mauritania
16	Mauritius
17	Mozambique
18	Namibia
19	Niger
20	Nigeria
21	Rwanda
22	Senegal
23	Sierra Leone
24	South Africa
25	Swaziland
26	Uganda
27	Tanzania
28	Zambia
29	Zimbabwe

Declaration

This thesis, my own original work, has not been presented for a degree in any other University and all sources of materials used for the thesis have been dully acknowledged.

Declared by:


Gedion Mekonnen

Certified by:

Dr. F. Wouterse

