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I Introduction

The economic performance of countries has been rapidly improving throughout history and most of all in the previous century. Nearly all the countries in the world experience improved economic performance and increase in the income levels. However, an increase in the level of gross domestic product, does not by default imply a reduction in poverty as countries may still perform poorly in improving income equality as well as employment and educational opportunities.

In line with recent growth strategies (Europe, 2020; Strategy 2020; African Inclusive Growth Agenda) as well as acheiving Sustainable Development Goals (UN Genelar Assembly, 2014a)[1], countries are faced with targets of accomplishing smart, sustainable and inclusive growth, highlighted as key objectives and priorities to reach. While these concepts are clearly imposed as important task in front of countries, their conceptualization demands more attention. Although, much have been said about sustainable growth and having in mind the growing theoretical body of smart growth (WCED, 1987; Redclift, 2005; European Commission, 2010; Foray, David & Hall, 2009; Barca, 2009), the term inclusive is falling behind in theoretical clarification. Eventhough, there is a recent growing empirical and theoretical literature, there is no achieved consensus on the determinants of inclusive growth and how the concept may be operationalised. However, experts have emphasized that poverty can be reduced at a faster rate when inclusive growth strategies are applied and when special income distribution policies are undertaken (Chenery & Ahluwalia, 1974). This calls for further studies, that can improve poverty analysis and contribute to the design of inclusive growth policies. This paper makes a contribution in that direction.

The first part of the paper surveys previous studies in terms of indicators of inclusive growth and its determinants. Despite of giving a theoretical framework to the term inclusiveness, this part provides a discussion of the different concepts of inclusive growth, highlights the most important content as well as differences and similarities between definitions. This part provides review on the empirical literature on the topic and analyses the different approaches in measuring inclusive growth.

The second part examines technology variables and their influence on inclusive growth for over 100 developing countries. Although, it is not consensual, the measure for inclusiveness in this study is the commonly used measure for poverty, the headcount ratio. This variable is a measure of the percent of people living below international poverty line[2] and represents an incidence dimesion of poverty. Additionally, the influence of technology is tested on the poverty depth dimension, by introducing a second dependent variable that is the poverty gap. This variable gives poverty depth dimension throughout measuring the mean shortfall from the poverty line. The study uses poverty and inequality data, obtained from World Bank´s Povcal database. Access to technology is represented by economic infrastructure variables (McKiney, 2010): access to electricity, fixed lines and mobile subscriptions as a proxy for access to information and communication technology (ICT) and paved roads per kilometers as proxy for access to road infrastructure. The latest available data set on poverty and access to technology were combined and the year 2010 was chosen as the most suitable for cross-sectional analysis. The empirical model presented in this part provides analysis on economic infrastructure on poverty incidence and poverty depth in devel-

[1] In Juli 2014, the UN General Assembly forwarded proposal of Sustainable Development Goals to achieve until 2020, as replacement of Millenium Development Goals that expire in 2015.

[2] From 2008, World Bank sets new international poverty line which is $1.25 a day.

oping countries, according to UNDP classification[3]. Thereby, countries with low, medium and high Human Development Index (HDI) in 2010 are taken into consideration. Data used as proxy for access to technology were obtained from World Development Indicators Database and CIA World Factbook. The analysis includes 109 countries under investigation of the main question of consideration, that is how access to technology influence inclusivity of growth throughout the process of alleviating poverty in the developing countries. The results show significant and negative relationship between technology, represented through economic infrastructure and poverty.

However, results need to be interpreted with coution due to two main limitations of the study. The study recognizes that the headcount poverty ratio and poverty gap are not consensual measures of inclusive growth. The second one entails empirical issues in terms of the econometric methodology used in asserting the effect of technology on poverty. Namely, there is an effect of endogeneity, because of omitted variables, which causes biased and inconsistent estimates. Furthermore, reverse causality between technology and poverty may be taking place, which can not be addressed using cross-sectional analysis.

Nevertheless, the contribution of the study is multiple. Giving a conceptual framework of the term inclusiveness it contributes for explicating and clarifying the central proposition of the concept. This is of main importance to the policymakers, especially now, that the target is imposed for the countries and further clarification is missing. Although the paper is one of the many investigating the link between technology and poverty, its among the first one linking technology and invlusive growth. While testing the correlation between technology accessibility and inclusiveness, I will try to point out the importance of the first one for the occurrence of the second. The study is giving an answer to the question whether technology, in terms of economic infrastructure, can be seen as an indicator for inclusive growth.

The first part of the thesis is devoted to investigate the concept and its main characteristics. The theorethical framework is developed in section 2, where the emergence of the concept is explained and different approaches in defining the concept. Then, a literature review on previous studies trying to assess the concept empirically is also provided. The second part of the thesis analyses how technology influence inclusive growth. Section 3 gives the main links between technology in terms of econometric infrastructure and inclusive growth. The empirical approach is explained in section 4, whereas the results and analysis are provided in section 5. Section 6 discusses the conclusion of the thesis and gives implications for further research.

[3] UNDP classifies the countries as countries with low Human Development Index, which values range from 0.20-0.55. Countries with medium HDI have HDI between 0.55-0.70. High HDI countries are the ones in the rage of 0.70-0.80; and very High HDI countries have HDI of 0.80 and above. List of countries by HDI used in the study provided in Appendix 6.

2 Inclusive Growth – Theoretical Framework

This part gives insights of the appearance of the concept and its development into what it represents today. For this purpose, conceptualization of the pro-poor growth is provided as well as the main differences and mutual interactions between these two. Moreover, two dimensions of the concept of inclusive growth are highlighted together with an assemblance of the characteristic features that it entails. The last part contains review on the literature of indicators and determinants of inclusive growth.

2.1 From pro-poor to inclusive growth

The term inclusive was first used in the beginning of the century when Kakwani and Pernia (2000) employed it to highlight the nature of what they considered to be an upgrade of the concept of pro-poor growth. The reference to it as "*inclusive economic growth*" intended to stress the particular attributes that make pro-poor growth distinct. These two terms should not be misused. Inclusive growth is at the same time a pro-poor growth whereas the opposite relation is not necessarily true (Ianchovichna & Lundstrom, 2009).

Speaking of the attributes that make growth inclusive, it should be noted that they differ according to the different concepts of the pro-poor growth that they are in line with. Namely, the growth can be pro-poor in absolute terms if this growth raises the incomes of poor people (regardless what happens with inequality). On the other hand, growth can be pro-poor in relative terms if the incomes of the poor people rise more than proportionally of the rise of total incomes, meaning inequality decreases (Zependa, 2004). While, some inclusive growth definitions are interchangeable with the absolute pro-poor growth definition (Ravallion, 2004; Ianchoivicna & Lundstrom, 2009; Habito, 2009; Klasen 2010), most studies acknowledge that reducing both, poverty and inequality is at the heart of the meaning of inclusive growth. (Ali & Son, 2007; Rauniyar & Kanbur, 2010; UNDP, 2013). However, these are not the only attributes that constitute the concept of inclusiveness.

While pro-poor growth is concerned mainly with poverty reduction, inclusive growth definition evolved this concept by enhancing it and widening the focus. It is notable that while in the central concerns of the pro-poor concept are poverty (absolute definition) and inequality (relative definition), where the focus is on income levels and distribution (Kakwani & Pernia, 2000; Dollar & Kraay, 2002; Ravalion, 2004), most of the definitions of inclusive growth have incorporated non-income dimension into the pro-poor notion. And instead of constraining only to outcomes, inclusive growth incorporates the way through which development happens. The center of the concern is that in addition to imparting the benefits of growth, individuals should effectively take part and participate in the growth process (World Bank, 2008), while the benefits should be equally distributed to all of the participants in the process of growth. Ramos and Ranieri (2013) explain the expansion of opportunities for participation as complemental part of distributing the benefits equally.

2.2 Different approaches in defining inclusive growth

A number of different approaches in defining inclusive growth are provided in Table 1. For better comprehension of the definitions, the study recognizes that the concept has two dimensions. A process dimension**,** refering to participation and an outcome dimension that stands for benefit sharing. In terms of process, inclusion means including as many people as participants in the process as possible. It can be characterized as broad-based growth across sectors that includes non-discriminatory participation for businesses and individuals. In this context, inclusive growth is somewhat related to broad-based or labor-intensive growth (World Bank, 2008). Speaking in terms of outcome dimension, the difference be-

tween the alignment with the absolute or the relative definition of pro-poor growth becomes visible. The outcome dimension in absolute terms would be decreasing poverty or number of people living below certain poverty line. In terms of outcome, using the relative definition, the growth would be inclusive if it benefited the poor more then it benefited the whole population. The later definition has been subjected to critiques that are discussed later in this section.

Depending on different initial levels of development across regions, the term is differently defined. The definition that the European Commision proposes entails fostering a high-employment economy that should deliver economic, social and territorial cohesion through investments in skills, fighting poverty and moderising labour markets and social protection systems (European Commission, 2010)[4]. Asian Development Bank, in the working paper Strategy 2020, emphasizes the three most important pillars of inclusivity: education, employment and healthcare**.** Growth is inclusive if these three pillars are increasing together with an income measure such as GDP per capita (Asian Development Bank, 2008).[5] African Development Bank recognizes: "*wider access to sustainable socio-economic opportunities for a broader number of people, regions or countries, while protecting the vulnerable, all being done in an environment of fairness, equal justice, and political plurality*". Here, the concept is widened to include political dimension that means supporting the voices and democratic accountability of the poorest and vulnerable groups (African Development Bank Group, 2012, p.2)[6].

A summary of the different definitions existing in the literature points out that this type of economic performance should meet 4 requirements: increase in income measures, decrease in inequality, decrease in poverty, and increase in non-income measures of wellbeing, such as opportunities. The definitions mostly differ as to whether they are aligned to the absolute or relative pro-poor concept. Nevertheless, they all recognize that increasing the standards of living of all, while including the poor into economic and social participation is the central proposition of the concept.

The first two requirements that should be met for achieving inclusive growth imply economic growth in income measures and increased equality in income distribution. Income distribution is usually represented by Gini index that measures the extent to which actual income distribution in a country deviates from perfect distribution. It takes values from 0 to 100 where 0 represents perfect equality among distribution and 100 is perfect inequality, meaning high Gini represents high inequality in the country.

The last two requirements in the literature are referred to as inclusive development (Klasen, 2010; McKinley, 2010; Rauniyar & Kanbur, 2010). It describes (but its not limited to) including the poor in the economic and social participation by providing job opportunities, investment on the education and providing improved healthcare. It is understood as activities or projects that improve the living standards of people other then income measures. According to Rauniyar and Kanbur (2010), the concept includes human capital development, social capital development and increased gender equality. Human capital development refers to access to education, primary health care, and other essential services. Social capital development means increasing the opportunities of the poor to participate in decision making and self-managed community services such as in creating community-based groups in microfinance, and natural resources management. Gender development involves

[4] European Commission. (2010). Europe 2020 - A strategy for smart, sustainable and inclusive growth.

[5] Asian Development Bank. (2008). Strategy 2020 – The Long Term Strategic Framework of the Asian Development Bank.

[6] African Development Bank Group. (2012). Inclusive Growth Agenda. Policy Brief 6.

improving the status of women through promoting their participation in the development of society. Social protection addresses the vulnerabilities and risks of age, illness, disability, natural disasters, economic crises, and/or civil conflict (Rauniyar & Kanbur 2010).

For illustration of the importance of inclusive development on poverty, the figure provided below represents countries used in the empirical analysis and their macroeconomic performances in 2010. In the figure, the countries are plotted according to the first two requirements of the concept, that are income growth and inequality[7]. The figure demonstrates that countries with low, medium and high Human Development Index performed nearly the same in growth and inequality measures, but the poverty in the countries with high HDI is smaller by half. This is due to the improved human development, which is only a part from inclusive development concept, yet plays a crucial role in poverty alleviation.

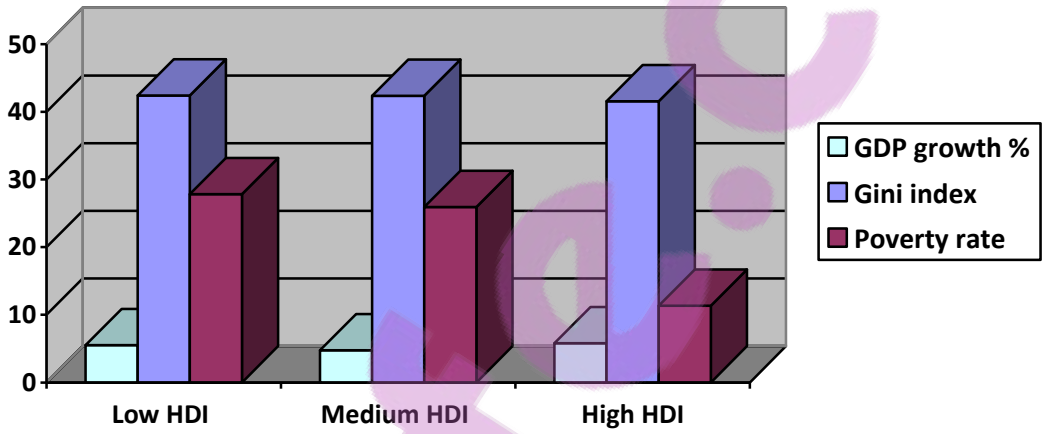

Figure 1. Growth, inequality and poverty in countries with low, medium and high HDI

2.3. Indicators and determinants of inclusive growth

Measuring the inclusiveness has imposed a challenge in the literature, since the concept started to be minced. The number of studies measuring this type of growth is still limited and while the concepts they propose are far away from consensual, everyone of them contributes to exploring this term and providing new possibilities of measurement to be taken into account. Similarly to the definition process, the process of measurement has been quite complex as to the indicators used as well as to the results obtained. In the limited number or emprical studies, the orientation of the debate towards a more comprehensive definition/measure is notable, replicating that the center of the concept is decreasing poverty. The employment of different definitions of the concept in the empirical literature, contribute to different outcomes which should not be surprising. Table 1 sums the different indicators and findings in the recent empirical literature.

One of the earliest attempts to study the magnitude of inclusive growth among its most important constitutes is applied to the case of Philippines (Ali & Son, 2007). The proposed methodology is applied only to two measures which are 1) Employment and 2) Basic social

[7] Full list of countries used in the empirical part and classified according to HDI are presented in Appendix 6.

Table 1. Measuring inclusive growth - different indicators and findings

Title	Author	Publication year	Indicator	Data period	Findings
Defining and Measuring Inclusive Growth: Application to the Philippines	Ifzal Ali and Hyun H. Son	2007	Social opportunity curve	1998	Health services and benefits from basic infrastructure are not equally shared among population. Employment is unequally distributed among man and women.
Inclusive Growth Analytics: Framework and Application.	Ianchovichna and Lundstrom	2009	Inclusive Growth Analytical Framework	1960 - 2007	Application of the framework to Zambia: High indirect costs, market coordination failure, low access to secondary and tertiary education and weak governance are the biggest factors that impede inclusiveness.
Inclusive Growth Criteria and Indicators: An Inclusive Growth Index for Diagnosis of Country Progress	Terry McKinley	2010	Inclusive Growth Index constructed of different indicators	2005 - 2007	Conducted 5 Case studies in which IG index was calculated. A score of 1-3 is regarded as unsatisfactory, 4-7 is satisfactory progress and score 8-10 is superior score. In the case studies Bangladesh IG index was 4.55; Cambodia: 5.05; India: 5.70; Indonesia: 4.40; Philippines: 3.80.
Measuring and Monitoring Inclusive Growth: Multiple Definitions, Open Questions, and Some Constructive Proposals	Stephan Klasen	2010	Model of analysis at project/program level	NA	Inclusive growth model of project/program considers whether it reduces poverty and increases employment of people living bellow $2.50/day indicator (as direct and indirect beneficiaries). Does it reduce social disparities of non-income measures and promotes human capabilities and whether it delivers benefits beyond improvements in human capabilities.
Inclusive Growth Revisited: Measurement and Determinants	Anand Rahul, Saurabh Mishra and Shanaka J. Peiris	2013	Estimated Inclusive growth income containing level of income and index of income distribution	1970 - 2010	Macroeconomic stability, human capital, and structural changes are foundations for achieving inclusive growth.
Determining the Correlates of Poverty for Inclusive Growth in Africa. African Development Bank Working paper	John C. Anyanwu	2013	Poverty headcount ratio	1980 - 2011	Income inequality, primary education, mineral rents, inflation, and population increase poverty. Real per capita GDP and secondary education have negative effect on poverty. Trade openness has positive but insignificant effect.

services in: a) education, b) health service and c) infrastructure. In this study, the authors are measuring inclusiveness by calculating a social opportunity function, which depends on the average opportunities available to the population, and how opportunities are shared or distributed among different deciles of population. Results show that various opportunities, although increased, are not equally distributed among poor and between men and woman.

By setting the opportunities in the center of the attention, the authors basically are measuring only the inclusive development dimension without introducing an income measure. Consequently, their estimation by this type of methodology is not fully comprehensive.

More recently, Anand et al. (2013) use a panel regression on average 5 year data from 1970-2010 for 143 countries. It is the first paper to include growth of income and equity of distribution into one measure. The dependent variable is the inclusive growth levels y* which are developed using framework of Ali and Son (2007), with the difference that the indicator is the income measure. The results show that macroeconomic stability, human capital and structural changes are the key determinants of inclusive growth in the emerging markets. This is one of the few studies connecting ICT[8] and inclusive growth. The ICT variable was found to have negative but insignificant effect for which the authors suspect it is the consequence of lacking data of this type for the emerging economies.

Another attempt to identify the variables that promote inclusiveness is the study by Anyanwu (2013). He uses a number of different empirical models to examine the link between poverty and other economic indicators. The OLS results were robust to the employment of Feasible Generalised Least Squares (FGLS), two-stage Least Squares instrumental variables (2SLS) and Generalised Methots of Moments Instrumental Variables (IV - GMM). The dependent variable is Poverty headcount ratio which is the percentage of the population living below $1.25 a day. The results show that higher levels of income inequality, primary education, mineral rents, inflation, and higher level of population increase poverty. On the other hand, higher real per capita GDP, and secondary education have negative effect on poverty. According to these model Trade openness is positively but insignificantly correlated with the headcount. The paper does not include any variable as a proxy for technological access.

Ianchovichna and Lundstrom (2009) provide an analytical tool to assert inclusivity on a country basis. In their study they propose a framework to identify and prioritize country specific constraints to inclusive growth illustrated in Figure 1. The framework is applied to Zambia and results show that the main factors impeding inclusive growth are market and government failures. Coordination failures are especially severe for the poor who cannot afford the fixed cost associated with finding alternative sources for inputs. Weak governance, in particular poor government effectiveness, is a factor behind the government failures and is as such a major obstacle to inclusive growth.

Ianchovichna and Lundstrom (2009) also provide a discussion in terms of measurement of inclusiveness. They discuss the disadvantages of inclusive growth in line with relative pro-poor growth saying that the relative definition could prompt problematic results for both poor and non-poor households. For example, a society attempting to reach pro-poor growth under the relative definition would favor an outcome where average income growth

[8] The variable was measured as total stock of ICT software and hardware-related investments as a share of total capital stock.

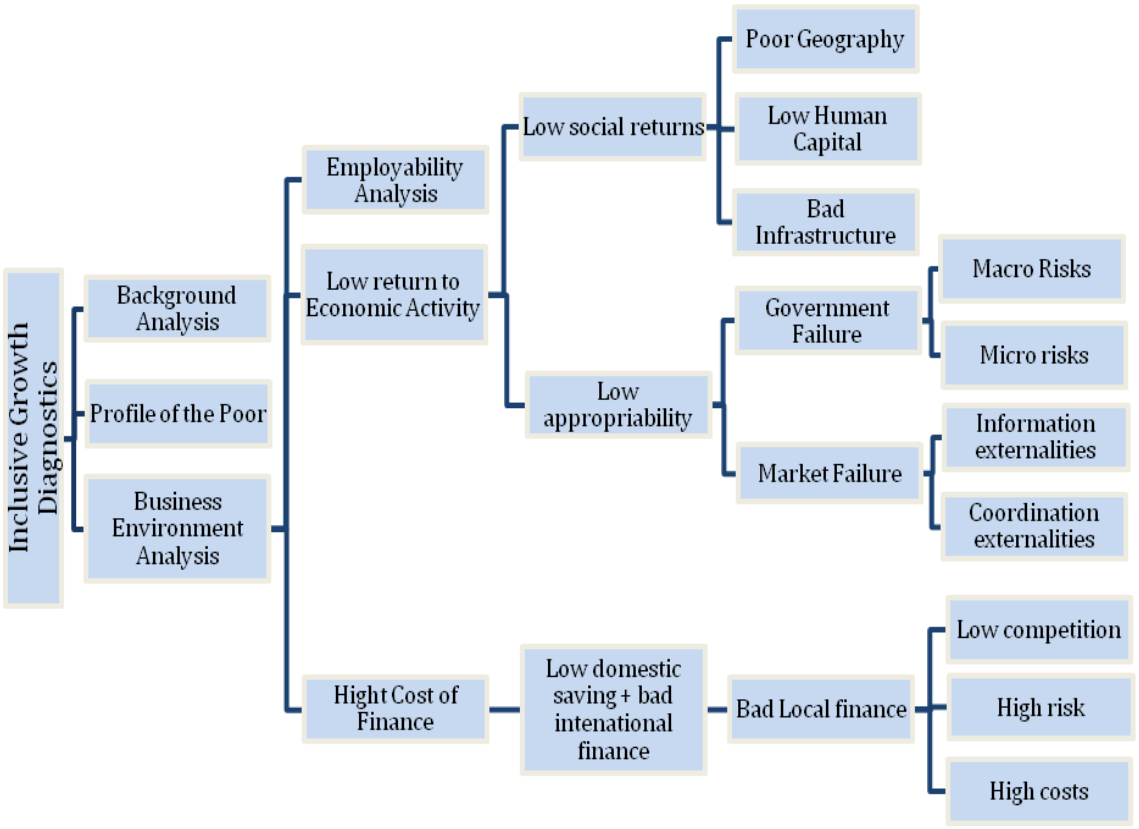

Figure 1. Inclusive growth framework
Source: Adapted from Ianchovichna and Lundstrom (2009)

is 2 percent of the whole population and 3 percent of the poor ones over an outcome of average growth rate of 6 percent where the income of poor grew by 4 percent. In this context they rely on the Department for International Development[9] definition and emphase that when poverty reduction is the objective, then the absolute definition of pro- poor growth is the more relevant. In line with the claiming in the literature, the study is defining inclusiveness in absolute terms.

The same framework has been applied to Nicaragua in another study (Vargas, García & Escamilla, 2013). For this country, the impeding factors of inclusiveness stem manly from lack in human capital and bad infrastructure. The authors also found that there is a low provision of public goods, like transport infrastructure, access to electricity, water and sanitation system. Among the other factors constraining inclusivity in Nicaragua are government failures (fragile fiscal situation, weak institutions and corruption) and market failures (little diversification of exports, inability of business to broaden production).

McKinley (2010) proposes different conceptual frameworks for measuring inclusive growth on a country level and on a project or programme level. He proposes estimation of Inclusive growth index which is constructed by different macroeconomic indicators to which different weights of importance are attached. Growth in income has been given the highest weight – 25%, rate of employment enters this index with 15% weight. Infrastructure, to-

[9] Department for International Development (2008) refers to the absolute definition of pro-poor growth in light of the commitment to the MDG Goal of halving absolute income poverty by 2015.

gether with poverty and inequality enter the index with 10% weights. Another indicators with smaller weights are health and nutrition, education, gender equality, social protection and sanitation and water.

However, Klasen (2010) claims that country-level indicators would be inreliable to assess how certain projects or programs lead to and impact inclusive growth. Therefore, he proposes an analytical framework to assert the inclusiveness of certain projects/programs. He explains that in this case the focus should be put on whether the project/programme aim to reduce absolute income poverty, increase the employment of poor people and remove social disparities among the poor as well as members from disadvantaged ethnic minorities, females, people with disabilities etc. Also it should be considered whether the project/program promote the human capacities in terms of health and education so that they are able to better contribute and benefit from economic growth and does the project/program is likely to deliver benefits in non-income dimensions above the improvements in human capacities such as: reductions in infant mortality, improved nutrition and social security, better social integration, improved housing, etc.

In terms of indicators, a summary of the empirical literature indicates that macroeconomic stability, structural changes and human capital are the main factors contributing to inclusive growth, whether inequality, population, and low educational attainment are the main factors impeding inclusivity. The theoretical framework from Ianchovichna and Lundstrom (2009) points out that low social returns may arise from bad infrastructure, despite unfavourable geography and low human capital. Accessibility to technology and improved infrastructure, is contributing to inclusive growth by utilizing the process of production and creating new job opportunities. Improved infrastructure also increases the returns to human capital by increasing total factor productivity and leads to self-sustained growth in the long run (World Bank, 2008). On the other side, this type of technology "works" against the impeding factors of inclusive growth, equalising returns to labour and increase opportunities through job creation.

On the grounds that previous empirical analysis stop at the point of determining the relationship of technology (Anand et al., 2013), the main motives behind this research would be to account for this variable in the empirical analysis. As a measure of the poverty, the study has implemented the mainly used measure of poverty incidence that is the Headcount poverty ratio. The study takes into consideration White and Anderson (2001) critique on the headcount ratio, stating that it only measures the poverty of people "*just around*" the poverty line and does not give information about depth of poverty. In order to capture the influence of technology on the depth of an analysis of poverty gap is implemented in the empirical part. By the same token, it is following Adams and Page (2005) methodology of depicting the effect of remittances and migration on the different dimensions of poverty.

Although the proposition may seem self evident, it has never been tested and analyzied from the inclusive growth perspective. By investigating how the access of technology leads to direct and indirect alleviation of poverty, the study reveals in what ways economic infrastructure influences inclusive growth and inclusive development.

3. Technology and Inclusive Growth

This section explicates the linkages between technology and inclusivity. It disentangles between the effects of economic and social infrastructure. Giving theoretical foundations the most important implications economic infrastructure are provided through linking empirical studies and their inference from inclusive growth and inclusive development perspectives.

3.1 The link between access to technology and inclusive growth

The more recent type of economic models of the endogenous growth literature by Romer (1990), Grossman and Helpman (1991) and Aghion and Howitt (1992), all share the characteristic that a technology is crucial for economic growth and that continued increase in the level of resources spent on the creation of new technologies leads to a continued increase in economic growth.

The development practitioners today, tend to emphasize the importance of reliable and affordable technology and infrastructure for reducing poverty and its contribution in the achievement of Millenium Development Goals. However, it should be stressed that access to technology is not a goal in itself, since technology is a mean for achieving development goals decreasing poverty and increasing opportunities (Pigato, 2001).

Both, economic and social infrastructure, are crucial ingredients for the concept of inclusive growth. Economic or "hard" infrastructure refers to the large physical networks necessary for functioning of a modern industrial nation: transporting and water infrastructure, electricity and communication infrastructure and facilities. It brings about economic development. Social or "soft" infrastructure refers to institutions required to maintain health, cultural and social standards of a country, financial system, education system, health care system, government, law enforcement. Social infrastructure brings about human development.

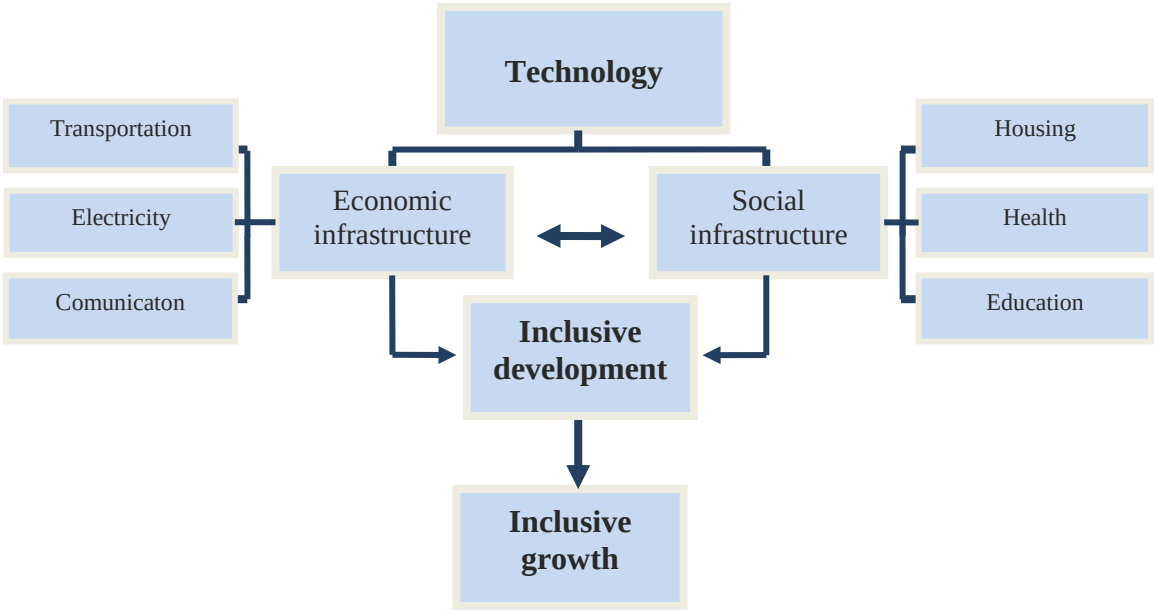

Figure 2: The influence of technology on inclusive growth
Prepared by author

However, it should be noticeable that there are interactions and interdependences among economic and social infrastructure that can affect the outcome in terms of inclusive growth. Namely, as the access of economic infrastructure is a fundament for further improvement of social infrastructure, the advancement of the later also affects the former. For example, the level of education affects how people use technology and on the other side, technology access improves education (Norris, Sullivan, Poirot & Soloway, 2003). Although, acknowledged, the causal links between social and economic infrastructure are not the focus of the study, but rather how economic infrastructure affects inclusive growth throughout poverty alleviation. It is also observable that the concept of inclusive development, involves human capital development and social capital development (health and education), but is not limited to. As previously explained, the concept also includes employment, gender development and social protection (Raynar & Kanbur, 2010)[10].

One possible option for explaining the influence of this type of technology and inclusive growth is if we use the knowledge and experience together with vast empirical body stating that this type of technology is:

- Increasing growth;
- Reducing poverty;
- Inducing opportunities and improving the standards of living.

By simply applying analogous reasoning, we have incentive to state our hypothesis that technology, in this case economic infrastructure, can create inclusive development and inclusive growth.

3.1.1 Economic infrastructure – theoretical implications from inclusive growth perspective

There are many macroeconomic studies that have tried to empirically link public infrastructure investments to economic growth (Aschauer, 1989; Canning & Bennathan, 2000; Straub & Terada-Hagiwara, 2011). For the case of economic infrastructure, studies show that investment in their quantity, as well as quality, contributes positively to economic growth (Calderón, 2009; Xueliang, 2013). In addition, studies show that infrastructure investment reduces inequality (Calderón & Servén, 2004a). In fact, good transport network reduces transport costs, road congestion and promotes industrial development throughout the country. The supply of electricity, on the other hand, is believed to be a fundamental requirement for economic and social development (Kanagawa & Nakata, 2008). Communication technologies through the supply of information enable the society to accommodate and appropriately manage economic information in order to increase overall welfare (Suregeni, 2008).

There is a widely debated issue in the literature on the subject whether policies that aim to increase growth are decreasig poverty at the same time (Dollar & Kraay, 2002; Ghura, Leite & Tsangarides, 2002). Thereafter, this study is closely investigating the direct link between economic growth and poverty alleviation that stems from access to technology, in developing countries context. In order for all the requirements for inclusive growth to be met, it is

[10] Gender development involves improving the status of women through health and welfare programs and promoting their participation in the development of society. Social protection addresses the vulnerabilities and risks of age, illness, disability, natural disasters, economic crises or civil conflict.

also important to assess how and whether economic infrastructure promote equality and increase opportunities for all, with the emphasis on the poor and disadvantaged groups.

This study focuses on three types of technology, represented as economic infrastructure as explained in the previous section. Although, economic infrastructure is not limited only to transport, electricity and ICT infrastructure, the analysis provided below investigates the linkages between these three types of technology and how they affect inclusivity through poverty alleviation.

According to Kingombe (2012), transport projects, in particular rural ones, are more concerned with progress and performance monitoring rather then impact assessment, over the last decades**.** Project management finds it easier to organize and support baseline studies than fund and support follow up surveys. A lot of transport related poverty assessments are not done because of the time lag between the project and the effects[11]. However, it is evident that despite reducing transportation costs, improved road infrastructure also reduces the costs of consumption and production of goods and services (BIDS, 2004). With easier access to markets and technology, improved roads expand farm and non-farm production through increased availability of relevant inputs and lower input costs (Binswanger, Khandker & Rosenzweig, 1993; Jacoby, 2000). A study for road development in Bankgladesh (Khandker, Bakht & Koolwal, 2009) explicates that improved road infrastructure led to improved education and health, including women and girls. Road-related studies have also suggested that household consumption is likely to get a boost from increased household income and consequently reduced poverty (BIDS, 2004; Fan, Hazell & Thorat, 2000). Khandker et al. (2006) point out that rural road investments has led to higher secondary school enrollment as compared to primary school enrollment and that road investments are pro-poor, meaning that they have benefited the poor disproportionately higher than the non–poor. Furthermore, transport disadvantage and transport poverty, as explained by Lucas (2012), is the main factor for social and economic exclusion.

Electricity is by itself, not a solution for the economic and social problems facing developing regions, although, the supply of electricity is believed to be a necessary requirement for economic and social development. Research show that electricity service appears to be one of the most important services for improving the welfare of the poor individual through the promotion of opportunities and increased standards of living (World Bank, 2001; WEO, 2012). This is because energy services have an effect on productivity, health, education, safe water and communication services (Human Development Report, 2007/2008). According to the Department for International Development (DfID, 2002), for one of the MDGs, gender equality and women's empowerment, energy access improvement directly contributes to freeing up women and girls from time-consuming housework such as laundry and cleaning by utilization of electricity. In addition, through reduction of time-consuming chores and attainment of energy services, it has indirect contributions for women to have the opportunity to attend schools or educational activities as well as to take part in the labor market or establish small enterprises. As a result, gender equality and empowerment of women are promoted.

Accesses to information and communication technologies, such as telephones, fax, internet, are providing knowledge to people in various levels regarding socio, political and eco-

[11] The stimulus of rural road investment on cotton production took seven years to emerge in eastern Zambia (Kingombe, 2012). Another study found that the range and availability of goods, services, employment and changes in primary school completion rates took six years to become statistically significant changes in Vietnam (Mu & Van De Walle, 2007).

nomic events happening around them. Although, using different proxies for access to information, a vast empirical body found negative relationship between access to telecommunication technology and poverty. Poverty is not only a state of lack of income but also a deficiency of information needed in to make appropriate living choices (OECD, 2005). Therefore, access to ICT alleviates poverty in many directions. Direct impacts involve improved education and educational tools in developing regions (Kenny, 2002), impact on health through improved medical information flow (ITU, 1999) and on productivity and income generation through access to market information (Suregeni, 2008). Using a cross-coutry empirical analysis, Suregeni (2008) shows that information capability of women[12] has higher negative correlation with poverty then income level, unemployment and inequality, for 70 developing countries. Having in mind that in these countries women belong to disadvantaged groups, investing in them would represent inclusive investment and would promote faster rate of growth, as suggested by the results.

Adapting a cross-sectional empirical model, this study is investigating the relationship between the level of economic infrastructure and the incidence as well as depth of poverty.

[12] Information capability of women is estimated by transforming fertility rate values instead of literacy rate which the author explains are not the perfect measure for access to information of women.

4. Empirical Model

This section explains the empirical approach used to address the second part of the research question. It contains theoretical motivation behind the methodology used in asserting the relationship between different technology variables and inclusivity. Additionally, description of data as well as definitions of the variables used in the model are provided.

4.1 Methodology

The headcount ratio as a proposed measure of inclusive growth is in line with the absolute definition of inclusiveness (DFID, 2004) as well as proposed measure of inclusive growth from an outcome perspective. This index was also suggested by Rauniyar and Kanbur (2010), as giving the "*degree of poverty aversion*". As they claim, for a given level of average income, inclusiveness can be measured simply by the degree of poverty (Rauniyar & Kanbur, 2010). White and Anderson (2002) point a critique to the usage of the poverty headcount ratio, stating that it only measures the poverty of people "*just around*" the poverty line and gives little to no information about the depth of poverty and the gap between the estimated poverty line and the poorest in the country.

The empirical estimation consists of multiple regression equations where the correlation between economic infrastructure variables and poverty are examined. In line with the general understanding and motivated by the critics of the indicator, the empirical model uses both the poverty headcount (as a measure of poverty incidence) and the poverty gap (as a measure of poverty depth).

The empirical model used in the estimation is based on the basic growth–poverty model suggested by Ravallion (1997) and Ravallion and Chen (1997), as well as the frameworks posited by Dollar and Kraay (2002), Ghura, Leite and Tsangarides (2002)[13]. Controlling for income level and its distribution, the relationship between certain variable and poverty is investigated.

By using the basic growth-poverty model, this study investigates the links between access to technology and poverty. Access to technology is represented by three different variables, namely, access to electricity, total network of paved roads per kilometers of total roads and the number of fixed and mobile subscriptions per capita. The model also implements regional dummies in order to account for the impact on poverty of unobservable regional specific factors. The dummies have been constructed following the World´s Bank classification of countries by six different regions. To avoid dummy variable trap, one dummy variable was omitted, representing the countries for Sub- Sahara Africa.

Controlling for income level and its distribution, the correlation between technology and poverty is being investigated, with and without the inclusion of the regional dummies. Furthermore, additional control variable that is secondary education is included in the model[14]. The effect of technology variables on poverty then is estimated controlling for both, regional effects and secondary education. Estimating the same equations on the poverty gap is giving information about the influence of these variables on the depth of poverty. Due to

[13] For empirical works using this model, see Agénor (2004), Islam (2004), Adams and Page (2005), Anyanwu and Erhijakpor (2010, 2012);

[14] To better reflect the influence of technology on poverty, various additional control variable were implemented, such as population, trade oppeness and employment rate. Because of their statistical insignificance in the model and the robustness of other coefficients on their inclusion, they were not included in the further analysis.

correlation between explanatory variables, not all variables are included in same specification.

The full model of the estimated relationship between the three different explanatory variables and poverty is presented in equations 1, 2 and 3. Equation 1 represents the linkages between poverty and electricity whereas the second equation is used to asses the relationship between poverty and road infrastructure. Equation 3 describes the estimated relationship between poverty and ICT.

$$\log P_i = \alpha_i + \beta_1 \log(y_i) + \beta_2 \log(g_i) + \beta_3 \log(e_i) + \beta_4 \log(el_i) + \beta_5 D_1 + \ldots + \beta_9 D_5 + \varepsilon_i \quad (1)$$
$(i = 1,\ldots\ldots,N)$

$$\log P_i = \alpha_i + \beta_1 \log(y_i) + \beta_2 \log(g_i) + \beta_3 \log(e_i) + \beta_4 \log(r_i) + \beta_5 D_1 + \ldots + \beta_9 D_5 + \varepsilon_i \quad (2)$$
$(i = 1,\ldots\ldots,N)$

$$\log P_i = \alpha_i + \beta_1 \log(y_i) + \beta_2 \log(g_i) + \beta_3 \log(e_i) + \beta_4 \log(ict_i) + \beta_5 D_1 + \ldots + \beta_9 D_5 + \varepsilon_i \quad (3)$$
$(i = 1,\ldots\ldots,N)$

In the equations above, P is the measure of poverty in country i, α is a constant parameter, β_1 is the growth elasticity of poverty with respect to income given by Y. β_2 is the elasticity of poverty with respect to income inequality given by the Gini coefficient, whereas β_3 is the elasticity of poverty with respect to the additional control variable – education. β_4 is the elasticity of poverty with respect to one of the variables of interest, such as, the elasticity of poverty to electricity, roads and ICT in Equation 1, 2 and 3, respectfully. D is a symbol that stands for the 5 regional dummies that are included in the full model and ε represents the error term. Because the empirical model uses two different poverty measures, that are poverty headcount and poverty gap, the same equations are also estimated with respect to the poverty gap as dependent variable.

The estimated results of the links between these variables to the poverty headcount ratio are presented in the first 3 specifications in all three tables (Table 3, 4 and 5), whereas the last three specifications (specification 3-6) show the results of the estimated relationship between the variables of interest and the poverty gap.

From the correlation matrix provided in Appendix 3, multicollinearity is observable, meaning that the technology variables are highly correlated. As explained before, this is the reason why the variables are tested in different specifications.

Heteroscedasticity violates the assumptions of constant variances for different observations of the error term, thus leading to bias standard errors. The Breuch- Pagan test for heteroscedasticity pointed on presence of heteroscedasticity in the model, since the null hypothesis was rejected. Therefore, all the estimations are made using heteroscedasticity-consistent standard errors.

A diagnostic check for normality of the distribution of the error terms was also performed according to which non-normal distribution of the errors was observed in all the regressions.

The relationship between both of the dependent variables and each of the independents are plotted and presented in Appendix 4.

4.1. Description of variables

The dependent variables used in this model are two different poverty measures, that are poverty headcount ratio and poverty gap. Headcount ratio is the relation between number of people living bellow certain level of income, referred as poverty line, and the total population in the country. This level of income is estimated after the main expenses for food and shelter as well as non-food consumption is extracted from the total income. International poverty lines are also adjusted for inflation over years, in order to remain constant in real terms and to enable meaningful comparison of poverty over time. The study from Ravalion and Chen (2008) used improved price data from the 2005 International Comparison Program to adjust for change of prices in cost of living, and suggested a new poverty threshold at $1,25 dollars a day, according to 2005 Purchasing Power Parity. From 2008 this poverty line is internationally accepted and used until today (previous poverty line was $1 and $1.08 dollars a day). This line is also representing the mean of the national poverty lines for the poorest 15 countries in the world[15].

Poverty gap is a measure for depth of poverty that is the amount of income by which the average income of the poor falls short of the poverty line. It is estimated with reference to a certain poverty line used, so in this model the poverty gap is estimated at $1.25 a day poverty line. The poverty gap is expressed as a percentage of the poverty headcount ratio. For instance, a poverty gap of 5% means that the poor have an expenditure shortfall of 5% of the poverty line. Another interpretation is that on average poor person´s income are 95% of the poverty line. The measure is also referred to as the cost of eliminating poverty, since it shows how much would have to be transferred to the poor to bring their income up to the poverty line.

The explanatory variables are access to electricity, ICT and roads. The variable access to electricity, available for only 2 years by the World Bank, represents percentage of the population with access to electricity. Electricity access, refers to the situation where people can acquire modern sources of energy at affordable prices (Kanagawa & Nakata, 2008). ICT variable is a proxy for communication technology in my model and it is also representing communication infrastructure. It is a sum of fixed line and mobile phone subscriptions. Fixed telephone lines are those that connect a subscribers terminal equipment to the public switched telephone network (PSTN). Mobile cellular telephone subscriptions are those that provide access to PSTN using cellular technology. Having advanced communication infrastructure and technology implies decreased costs and more available subscriptions to society through lower prices. Since there is no existing indicator for access to roads, the network of paved roads is taken as a proxy for transport infrastructure. The same logic follows, meaning if transport infrastructure is advanced and developed, there will be longer and denser road network implying higher access of roads to the people.

The standard control variables used in the basic growth model are income and inequality. Real Gross Domestic Product as an income measure represents the level of income earned by the population. The Gini index represents measurement of inequality through measuring income distribution of a country's residents. This number, which ranges between 0 and 1, is based on residents' net income and helps to define the gap between the rich and the poor.

[15] A country might have unique, national poverty line or separate poverty lines for urban and rural areas, as well as different geographic areas, in order to better reflrect differences in costs of living.

Secondary education is used as additional control variable to reflect possible interdependences between usage of technology and level of education[16].

Table 2 presented below, supplies full definitions of variables employed in the empirical model and thir sources, extended with the expected signs from each explanatory variable. Except from the variable roads, the other variables representing access to technology are expressed in per capita terms.

Table 2: Description of variables

Variable	Definition	Source	Expected sign
Poverty headcount Ratio	Log of poverty headcount ratio is the percentage of population living on less than 1.25 a day at 2005 international prices.	PovcalNet data base (World Bank)	
Poverty gap	The mean shortfall of incomes from the poverty line (counting the nonpoor as having zero shortfall), expressed as a percentage of the poverty line.	PovcalNet data base (World Bank)	
Access to electricity	Percentage of population with access to electricity.	World Development Indictors (World Bank)	Negative
Roads, paved per km	Total network of paved roads per kilometers of total roads.	CIA World Fact Book World Development Indictors (World Bank)	Negative
ICT per capita	Fixed lines: sum of active number of analogue fixed telephone lines, (VoIP) subscriptions, fixed wireless local subscriptions and fixed public payphones. Mobile subscriptions: number of postpaid and active prepaid accounts.	World Development Indictors (World Bank)	Negative
Income	Gross Domestic Product per capita converted to international dollars using purchasing power parity rates.	World Development Indictors (World Bank)	Negative
Gini index	Measure of income distribution. The extent to which the distribution of income deviates from a perfect distribution.	World Development Indictors (World Bank)	Positive
Secondary Education	Total enrollment in secondary education, regardless of age.	World Development Indictors (World Bank)	Negative
Regional dummies	East Asia, Europe and Central Asia, Latin America, Middle East and North Africa, South Asia. Sub-Sahara Africa is the omitted regional dummy.	Authors transformation	

[16] As found in the empirical study of Anyanwu (2013), as well as proposed by Tilak (2007), secondary and higher education are more relevant for poverty reduction than primary education.

5. Results and Analysis

This part presents the results of the empirical calculation on the link between technology and inclusive growth. The relation between technology and poverty are provided and discussed, looking at economic infrastructure on more dissaggregated levels. The correlates of economic infrastructure are analyzed in terms of incidence of poverty as well as its depth. Different specifications are used to capture additional effects on poverty of other macroeconomic indicators.

The results obtained on the linkages between poverty and three variables of interest are presented in three different tables. Table 3 shows the outcome of the estimated relationship between poverty and access to electricity. Table 4 presents the correlations between poverty and roads, whereas the relationship between poverty and ICT is presented in table 5. Different specifications are used in each table in order to capture the influence of technology on different dimensions of poverty. As stated before, the first 3 specifications demonstrate the effect of technology on the incidence of poverty, and the last three specifications demonstrate the linkages between technology variables and the depth of poverty. Furthermore, specification 1 and 4 in all three tables, presents the outcome of the estimated basic growth-poverty model, where the effect of certain variable of interest and poverty is shown by controlling for income and inequality. The second and fifth specification are estimated including only reagional fixed effects, whereas specification 3 and 6 in all tables control for both, education and fixed effects. Thereafter, the estimation of the full model is represented in specifications 3 and 6 in every table. Considering the fact that the variables are expressed in logs, the coefficients are interpreted as elasticities.

Table 3 shows the results where Equation (1) is estimated using OLS. In the first two specifications all signs obtained are as expected. Furthermore, income level and Gini index are highly statistically significant and the variable access to electricity is also significant (Table 3, specification 1 and 2). The negative coefficient implys that the access to electricity is negatively correlated with the number of people living below poverty line, which is expected. The results, however, reveal lower elasticity of headcount poverty rate with respect to electricity access when unobservable region-fixed effects are included into the specification (Table 3, specification 2). This implies that unobservable regional effects were reflected in some part of the electricity coefficient, which eventually becomes smaller but still negative and statistically significant.

The previous results are not robust on the inclusion of secondary education as additional control variable in the third specification (Table 3, specification 3). Although, not significant, the inclusion of education changed the statistical significance of the objective variable. It is observable that the coefficient of access to electricity falls immensely and becomes insignificant. As it can be seen from the results, neither access to electricity nor education perform as expected when both included in the same specification.

The results differ with the change of the poverty measure. The next three specifications in the table demonstrate the effect of electricity access on the depth of poverty (Table 3, specification 4-6). Access to electricity is found to have negative and statistically significant effect on the poverty gap, when controlling for income level and distribution (specification 4). The negative and significant relationship stays robust on the inclusion of regional fixed effects (specification 5). This means that access to electricity proves to be significantly influencing the depth of poverty, even when controling for unobservable regional fixed effects. However, when controlling for both, fixed effects and education, the coefficient of electricity becomes insignificant (specification 6). The only variable with statistical significance in specification 6 is secondary education, implying that larger number of people

Table 3: OLS estimates of the effects of electricity accessibility on poverty

Variable	Dependent variable = poverty headcount ratio			Dependent variable = poverty gap		
	(1)	(2)	(3)	(4)	(5)	(6)
Access to Electricity	-0.928 (0.24)***	-0.803 (0.24)***	-0.410 (35)	-0.614 (0.26)**	-0.470 (-0.27)*	0.089 (0.39)
Per Capita GDP	-0.79 (0.21)***	-0.638 (0.21)***	-0.527 (0.23)**	-0.366 (0.23)	-0.259 (-0.23)	-0.141 (0.26)
Gini Index	2.250 (0.78)**	2.049 (0.87)*	2.25 (0.92)**	0.714 (0.85)	-0.580 (0.97)	-0.033 (1.03)
Secondary Education			-0.999 (0.61)			-1.465 (0.68)**
East Asia		-0.343 (0.5)	-0.31 (0.5)		-0.749 (0.55)	-0.684 (0.57)
Europe, Central Asia		-1.658 (0.54)***	-1.338 (0.56)**		-1.635 (0.61)**	-1.275 (0.66)**
Latin America		-0.815 (0.46)*	-0.896 (0.48)*		-0.134 (0.51)	-0.097 (0.54)
Middle East, Notrh Africa		-0.709 (0.63)	-0.96 (0.68)		-1.490 (0.73)*	-1.739 (0.80)**
South Asia		0.575 (0.65)	0.46 (0.66)		-0.653 (0.72)	-0.746 (0.74)
Constant	3.934 (3.01)	3.272 (3.36)	4.095(3.42)	4.837 (3.32)	7.653 (3.79)*	8.154 (3.83)**
N	107	107	100	106	106	99
Adj. R^2	0.457	0.502	0.494	0.160	0.199	0.223

Notes : All the variables are in logs. Estimates are made using robust standard errors. Standard errors shown in parenthesis. Number of observations reduced in the table because of missing values.
*Significant at the 0.10 level
**Significant at the 0.05 level
***Significant at 0.01 level

with secondary education is correlated with smaller poverty gap in the countries, as expected. The statistical insignificance of income and its distribution on the poverty gap, in every specification, are rather unexpected results (Table 3, specification 4-6).

The results obtained from the estimation of the full model on access to electricity on poverty, are in line with previous empirical studies that did not find significance on both, electricity nor education on the poverty headcount (Suregeni, 2005). Previous studies have pointed out some neutral, even negative impacts of electricity on poverty. Rural electrification is considered to have little or no impact on agricultural productivity in Indonesia owing to high connection costs, unclear land use rights, extremely low income levels, restricted credit access, and low potential for agricultural improvements. Therefore, many households opt not to connect to available electric power supply in this country (Ali & Pernia, 2003) . This is further explained by the fact that electrification infrastructure opens up opportunities to those who have a minimum amount of income, as a required threshold and therefore are better placed to take advantage of technology for poverty alleviation (Jalilian & Wies, 2004).

The results obtained on the estimated relationship between roads and poverty are shown in Table 4. In the first three specifications, the signs of the coefficients demonstrate the expected negative relation between this poverty measure and roads infrastructure (Table 4, specification 1-3). The correlation between road infrastructure and poverty headcount ratio is statistically significant and negative in every specification. The results are in line with previous studies on the relationship between road infrtastructure and poverty alleviation (Jalilian & Wies, 2004; Khander et al., 2006). The coefficient is slightly reduced when the regional fixed effects are included. As the output shows, these results are robust to the inclusion of the additional control variable accounting for secondary education, but then the coefficient of roads have decreased by nearly one half (Table 4, specification 3). As expected, the larger network of paved roads is negatively correlated with poverty as estimated by the full model (Equation 2).

An intriguing finding here, is that the correlation between transport infrastructure and poverty is even higher when the poverty measure is the poverty gap. (Table 4, specification 4-6). This means that although, the total network of paved roads negatively affects the incidence of poverty, it has an even higher negative influence on the depth of poverty. The coefficient representing roads is robust to the inclusion of the regional dummies and the additional control for secondary education. This can be further explained by the fact that the required threshold of income and/or human capital for exploiting opportunities brough by roads is lower.

The findings are in line with previous studies claiming that road infrastructure have higher effect on social and economic exclusion (and through this channel affecting the depth of poverty) then on the levels of income (Lucas, 2012; Xueliang, 2013). However, the lower value of Adjusted R^2, in this model, should not be neglected, demonstrating lower explanatory power of the variables used in the model on the poverty gap. Income level and distribution are again proved to be insignificant on the depth of poverty.

Table 5 displays the estimated relationship between access to ICT and poverty. From the table we observe noticeable influence of access to communication technology on poverty incidence (specification 1) that is somehow decreased when regional fixed effects are included and controlling for secondary education (specification 2 and 3, respectively). In this

Table 4: OLS estimates of the effects of paved roads on poverty

Variable	Dependent variable = poverty headcount ratio			Dependent variable = poverty gap		
	(1)	(2)	(3)	(4)	(5)	(6)
Roads, paved per km	-0.209 (0.08)**	-0.207 (0.08)**	-0.111 (0.09)*	-0.306 (0.08)**	-0.274 (0.09)**	-0.227 (0.10)**
Per Capita GDP	-1.236 (0.17)***	-0.957 (0.18)***	-0.617 (0.23)**	-0.575 (0.17)***	-0.397 (0.19)**	-0.163 (0.24)
Gini Index	2.591 (0.81)***	2.52 (0.88)**	2.538(0.89)**	0.662 (0.81)	-0.266 (0.94)	-0.108 (0.99)
Secondary Education			-1.272 (0.48)**			-0.929 (0.52)*
East Asia		-0.574 (0.5)	-0.402 (0.51)		-0.898 (0.53)*	-0.788 (0.55)
Europe, Central Asia		-1.615 (0.56)***	-1.352 (0.57)**		-1.359 (0.59)**	-1.051 (0.62)*
Latin America		-1.155 (0.46)**	-1.024 (0.48)**		-0.308 (0.48)	-0.133 (0.52)
Middle East, Notrh Africa		-0.84 (0.64)	-1.0129 (0.67)		-1.378 (0.68)*	-1.561 (0.72)**
South Asia		0.719 (0.69)	0.579 (0.68)		0.122 (0.73)	0.151 (0.75)
Constant	2.125 (3.09)	0.495 (3.47)	3.025 (3.52)	2.497 (3.18)	4.979 (3.7)	6.316 (3.81)
N	107	107	100	106	106	99
Adj. R^2	0.417	0.479	0.496	0.216	0.245	0.265

Notes : All the variables are in logs. Estimates are made using robust standard errors. Standard errors shown in parenthesis. Number of observations reduced in the table because of missing values.
*Significant at the 0.10 level
**Significant at the 0.05 level
***Significant at 0.01 level

context, the elasticity levels of poverty with respect to ICT are showing the same pattern as with respect to electricity access. (Table 3, specification 1-3). In this case, however, ICT coeffiecient stays robust to the differences in all the specifications. Even when controlled for both, regional effects and education, the relationship between poverty and ICT is negative and statistically significant. (Table 5, specification 3). Therefore, the results show statistical significance and negative relationship between the usage of ICT and poverty incidence, as estimated by the full model (Equation 3).

The variable is also found to be significant and negative with respect to the poverty gap, however, only in the forth specification (Table 5, specification 4). The coefficient becomes insignificant when regional fixed effects and secondary education are included (specification 5 and 6, respectively). Though, it is observable from the results that the access of ICT is not significant to the depth of poverty estimated by the full model. Only secondary education is found to be statistically significant and negatively correlated with the depth of poverty. The results obtained on access to ICT and poverty gap are similar to those of access to electricity on poverty gap (Table 3, specification 6 and table 5 specification 6, respectively). Accordin to the output from specification 6 in Table 5, only secondary education is significantly influencing the depth of poverty. This as well means that higher educational attainment implicates decrease in the depth of poverty.

The results obtained are in line with previous studies (Suregeni, 2008) estimating the relationship between access to information and communication technologies and the incidence of poverty. However, they are opposed to the results obtained when ICT and inclusive growth were directly investigated. In the IMF Working paper, Anand et al. (2013) explain the unexpected sign and the insignificance of the coefficient due to lack of data on ICT investments in emerging market.

The comparison across various coefficients representing technology, estimated by the full model, demonstrates the highest influence of ICT on the poverty incidence and the highest effect of roads on the depth of poverty. The lowest influence on poverty incidence, by the use of the full model, is shown by the coefficient of paved roads, which is however, the only one with statictical significance on the depth of poverty. Regardless of the measure used as a dependent variable, road infrastructure is negatively and significantly correlated with poverty, meaning that the amount of paved roads is related to reduced poverty as well as decreased depth of poverty.

Table 5**:** OLS estimates of the effects of ICT on poverty

Variable	Dependent variable = poverty headcount ratio			Dependent variable = poverty gap		
	(1)	(2)	(3)	(4)	(5)	(6)
ICT per capita	-1.451 (0.37)**	-1.206 (0.37)**	-0.838 (0.45)*	-0.806 (0.41)*	-0.657 (-0.41)	-0.125 (0.51)
Per Capita GDP	-0.651 (0.24)***	-0.473 (0.248)*	-0.305 (0.27)*	-0.339 (0.26)	-0.183 (0.27)	-0.091 (0.29)
Gini Index	1.627 (0.53)***	2.286 (0.86)*	2.335 (0.88)**	1.044 (0.84)	-0.403 (0.97)	-0.067 (1.02)
Secondary Education			-0.940 (0.53)*			-1.279 (0.6)**
East Asia		-0.526 (0.49)	-0.410 (0.5)		-0.851 (0.55)	-0.685 (0.56)
Europe, Central Asia		-1.719 (0.53)**	-1.325 (0.56)**		-1.671 (0.61)**	-1.262 (0.66)**
Latin America		-1.089 (0.43)*	-1.028 (0.47)**		-0.292 (0.50)	-0.078 (0.53)
Middle East, Notrh Africa		-1.057 (0.61)*	-1.226 (0.66)*		-1.684 (0.69)**	-1.727 (0.79)**
South Asia		-0.021 (0.63)	0.156 (0.63)		-0.961 (0.71)	-0.732 (0.72)
Constant	-2.955 (3.29)	-2.415 (3.61)	4.095 (3.42)	-0.306 (3.66)	4.363 (4.05)	7.631 (4.45)*
N	107	107	100	106	106	99
Adj. R^2	0.458	0.503	0.505	0.149	0.196	0.223

Notes: All the variables are in logs. Estimates are made using robust standard errors. Standard errors shown in parenthesis. Number of observations reduced in the table because of missing values.
*Significant at the 0.10 level
**Significant at the 0.05 level
***Significant at 0.01 level

6. Conclusion

Inclusive growth is attracting more and more attention in the economic circles. In relation with the inclusive growth concept, this study is devoted to investigate two issues. In the fisrt part of the thesis, the focus is explicating the meaning of inclusiveness by reviewing the literature and discerning and highlighting the important requirements that one economy must met in order to grow inclusively. The thesis acknowledges that there is a process and an outcome dimension of the concept that are subjected to differences in different definitions. Furthermore, four requirements should be met for any growth wave to be considered as inclusive: increase in income levels, and equality, reduction of poverty and increase of opportunities for all people.

The second part of the thesis attempts to empirically assess the influence of technology and the inclusive performance of the economy through the reduction of poverty. In this part, the imprint of economic infrastructure on poverty has been approached empirically with respect to the incidence of poverty as well as the depth of poverty.

According to the results, only transprort infrastructure is negatively correlated with both the incidence and the depth of poverty and therefore can be concluded that it leads to inclusive growth. Access to information and communication technology (ICT) show robust and negative influence on the incidence of poverty, but the relationship is not robust when the measure of poverty is the poverty gap. However, since access to ICT is significantly and negatively influencing the number of people living in poverty, it can be concluded that it also promotes inclusive growth. The results obtained in relation with access to electricity and poverty are not robust neither to changes in the poverty measure, nor to changes in specifications. Namely, access to electricity was only significant when controlling for income level and its distribution, but not when the specifications included regional fixed effects and secondary education as additional contoll variable. In this contexts, the effect of electricity access on poverty should be subject to further investigation.

The results obtained point out some important policy implications. Firstly, investment in transport infrastructure brings the economy closer to inclusive growth targets by alleviating the poverty ratio and the poverty gap. The access to information through ICT technology helps people to escape the life bellow poverty line, whereas the effect of electricity on poverty, as results show, is unclear. Furthermore, there are interdependences between technology and education. Education enables people to acquire and absorb new technologies. Therefore, increase in the access and the investment in infrastructure together with increase in human capital could have stronger impact on poverty reduction then either alone. Consequently, this implies a fundamental necessity of complementary policies, along side with access to technology, for effective poverty alleviation and achieving inclusive growth.

The limited number of studies on the topic implicate number of unsolved issues and areas for further research. Consensuality of a measure of inclusive growth for empirical research is one important issue. It is questioning that opportunities and chances for prosper can ever be econometrically captured, however, this should point the directions of the further efforts.

In terms of factors promoting inclusiveness, the availability of more diverse data will be important for further analysis of inclusive growth at national and regional level. Complementarity between the effects of both, economic and social infrastructure should be recognized and empasised in policy decision making and in further research. The interdependences between education and the use technology should be further addressed for most ef-

fective policy implications. The speed of technological advancement and the channels through wich it influence inclusivity is another important issue for further research.

Financial inclusion as well as government spending are another important areas for further research. The access to finance by the poor is a prerequisite for poverty reduction in order to achieve inclusive growth. The role of the banking sector for achieving inclusiveness has been recognized and has received some of the attentions of scholars. Government spending, on the other side, is of profound influence since it can easely target the poor by certain programmes or projects that address social and economic inclusion. How successful have these policies been from inclusive growth perspective is worthy of further investigation.

Until more certain consensus about inclusive growth indicator is reached, policymakers regarding the importance of the concept, should focus on projects and policies that will decrease the number of people living in poverty and enable a sourceful ground for it by clearing the poverty out of the way.

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Appendix 1: Different definitions of inclusive growth

Table 6. Different approaches in defining inclusive growth concept

Author(s):	Year of puplication:	Definitions of Inclusive Growth:
Kakwani and Pernia	2000	"Inclusive economic growth : pro-poor growth as a growth process that enables the poor to actively participate in and significantly benefit from economic activity."
Ali and Son	2007	"Growth is inclusive if it increases the non-income measures of wellbeing - social opportunity function, which depends on two factors: (i) average opportunities available to the population, and (ii) how opportunities are shared among the population."
Asian Development Bank - (Strategy 2020)	2008	"Inclusive Growth as growth that creates opportunities and allows all members of a society to participate in and contribute to the growth process on an equal basis. Thus, declining inequality in distribution of non-income dimensions of wellbeing such as employment, education and healthcare."
World Bank	2008	"Inclusive growth refers both to the pace and pattern of growth and it takes a longer term perspective as the focus is on productive employment as a means of increasing incomes for excluded groups...and to be sustainable it should be broad based across sectors and inclusive of large part of countries labour force"
Habito	2009	"…inclusiveness of economic growth […] as gross domestic product (GDP) growth that leads to significant poverty reduction."
Ianchovichina and Lundstrom	2009	"In short, inclusive growth is about raising the pace of growth and enlarging the size of the economy, while leveling the playing field for investment and increasing productive employment opportunities."
Rauniyar and Kanbur	2010	"Growth coupled with equal opportunities and consisting of economic, social and institutional dimensions."
McKinley	2010	"…two dimensions of inclusive growth: (i) achieving sustainable growth that will create and expand economic opportunities, and (ii) ensuring broader access to these opportunities so that members of society can participate in and benefit from growth."
Klasen	2010	"Inclusive growth is arguably more general [than pro-poor growth, as] it wants growth to benefit all stripes of society, including the poor, the near-poor, middle income groups, and even the rich.[…] in terms of outcome, inclusive growth could be termed 'disadvantage reducing' growth."
African Development Bank (Inclusive Growth Agenda)	2012	"Economic growth that results in a wider access to sustainable socio-economic opportunities for a broader number of people, regions or countries, while protecting the vulnerable, all being done in an environment of fairness, equal justice, and political plurality."
UNDP International Policy Center for Inclusive Growth	2013	"Inclusive growth allows opportunities for everyone to participate in the growth process while making sure that benefits are equalli shared....and reducing the disadvantages faced by the poor, both in terms of benefits enjoyed and in terms of access to opportunities for participation."
OECD	2014	"A rise in outcomes of income and non-income components of wellbeing of the most deprived segments of the population"

Appendix 2: Descriptive statistics

Table 7: Descriptive statistics

Variable	Mean	Median	Min	Max
Poverty Headcount Ratio	22.106	11.890	0.001	87.670
Poverty gap	8.024	3.490	0.000	49.010
Access to electricity	65.051	77.600	3.500	100.000
Roads, paved per km²	0.181	0.051	0.0002	2.270
ICT	0.839	0.862	0.089	1.953
GDP per capita	6 679.420	5 430.003	671.009	28 728.160
Gini Index	42.481	42.130	28.960	65.770
Secondary education	65.047	67.765	13.831	101.894

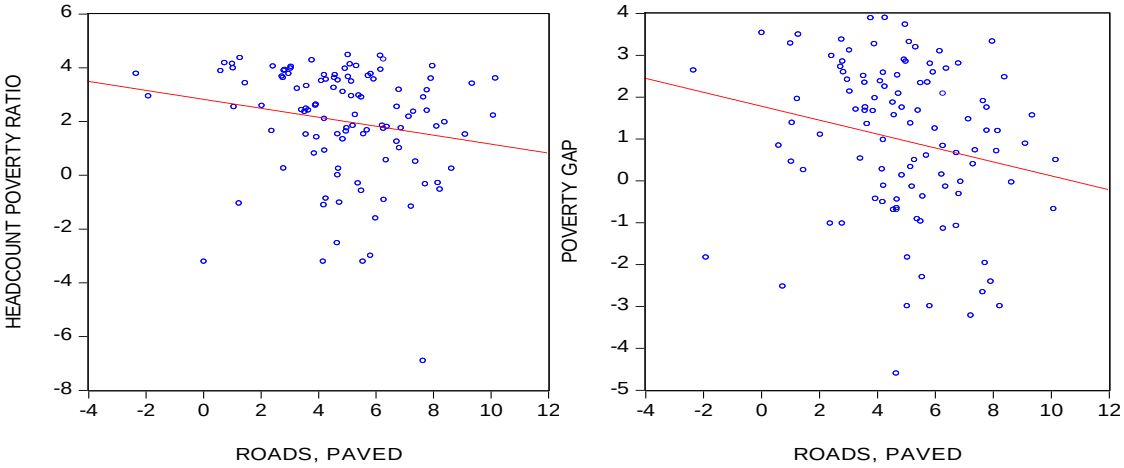
Appendix 3: Correlation matrix

Table 8**:** Pearson Correlation Matrix

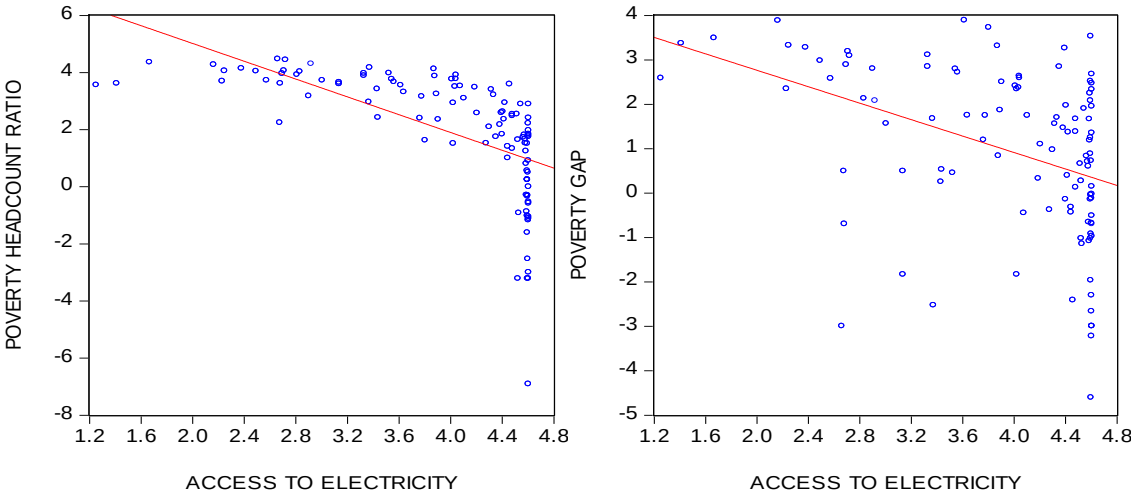
	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Headcount Ratio	1.000												
2. Poverty gap	.482	1.000											
3. LN GDP	-.564	-.358	1.000										
4. LN Gini Index	.197	.082	-.130	1.000									
5. LN Electricity accessibility	-.615	-.411	.550	-.084	1.000								
6. LN Roads Paved per km^2	-.115	-.204	.101	-.437	.578	1.000							
7 LN ICT	-.618	-.394	.647	.041	.863	.704	1.000						
8. LN Secondary education	-.580	-.460	-.663	.123	.380	.503	.674	1.000					
9. D East Asia	-.029	-.062	.042	-.041	.0.41	-.103	.207	.067	1.000				
10. D Europe, Central Asia	-.353	-.254	.112	-.261	.172	.263	.202	-.206	-.123	1.000			
11. D Latin America	-.223	-.037	.361	.379	.280	.062	.274	.041	-.171	-.123	1.000		
12. D Middle East, North Africa	-.196	-.201	.157	-.221	.195	.154	.302	-.162	-.098	-098	-.137	1.000	
13. D South Asia	.032	-.039	.001	-.218	.134	.052	.256	-.059	-.091	-.092	-.127	-.073	1.000

Appendix 4: Relationship between denepndent and independent variables

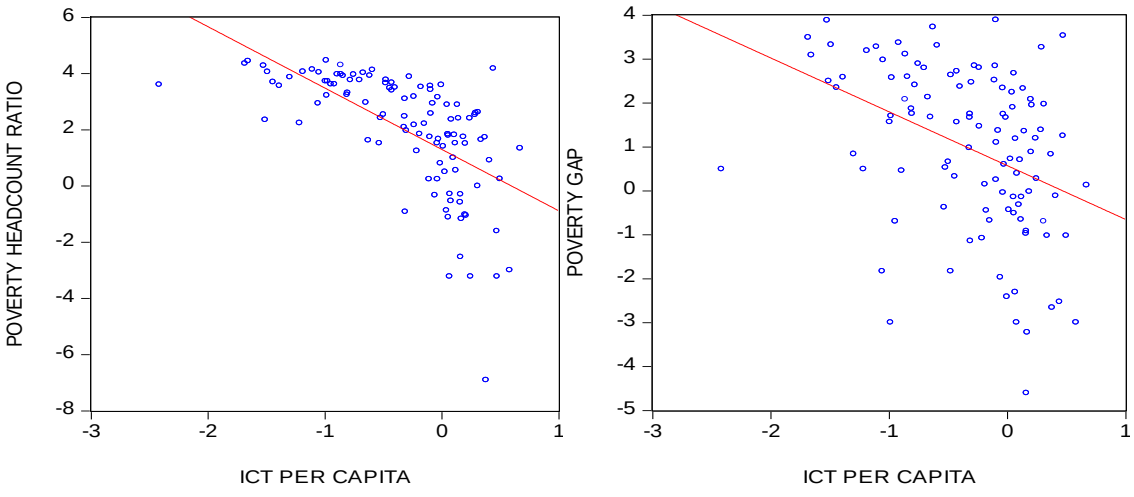
Relationship between poverty headcount ratio and poverty gap with roads:



Relationship between poverty headcount ratio and poverty gap with electricity accessibility:



Relationship between poverty headcount ratio and poverty gap with communication technologies:



Appendix 5: List of countries by region

East Asia and Pacific:

1. Cambodia
2. China
3. Fiji
4. Indonesia
5. Lao People´s Democratic Republic
6. Malaysia
7. Microneasia, Federal States of
8. Papua New Guinea
9. Phillipines
10. Thailand
11.Timor Leste
12. Vientnam

Europe and Central Asia:

13. Albania
14. Armenia
15. Azerbeijan
16. Bosnia and Herzegovina
17. Georgia
18. Kyrgyz Republic
19. Macedonia
20. Moldova
21. Serbia
22. Tajikistan
23. Turkey
24. Turkemistan
25. Ukraine

Latin America and Caribbean:

26.Argentina
27. Belize
28. Bolivia
29. Brazil
30. Colombia
31. Costa Rica
32. Dominican Republic
33. Ecuador
34. El Salvador
35. Guatemala
36. Guyana
37. Haiti
38. Honduras
39. Jamaica
40. Mexico
41. Nicaragua
42. Panama
43. Paraguay
44. Peru
45. St. Lucia
46. Suriname
47.Trinidad and Tobago
48.Uruguay
49. Venezuela

Middle East and North Africa:

50. Algeria
51. Djibouti
52. Egypt, Arab Republic of
53. Iran, Islamic Republic of
54. Iraq
55. Jordan
56. Morocco
57. Syrian Arab Republic
58. Tunusia
59. Yemen

South Asia:

60.Bangladesh
61. Bhutan
62. India
63.Maldives
64. Nepal
65. Pakistan
66. Sri Lanka

Sub-Sahara Africa

67. Angola
68. Benin
69. Botswana
70. Burkina Faso
71. Burundi
72. Cabo Verde
73. Cameroon
74. Central African Republic
75. Chad
76. Comoros
77. Congo, Democrtic Republic of
78. Congo, Republic of
79. Cote d´Ívore
80. Ethiopia
81. Gabon
82. Gambia, The
83. Ghana
84. Guinea
85. Guinea-Bissau
86.Kenya
87. Lesotho
88. Liberia
89. Madagascar
90. Malawi
91. Mali
92. Mauritania
93. Mauritius
94. Mozambique
95. Namibia
96. Niger
97.Nigeria
98. Rwanda
99. Sao Tome and Principe
100. Senegal
101. Seychelles
102. Sierra Leone
103. South Africa
104. Sudan
105. Swaziland
106. Tanzania
107. Togo
108. Uganda
109. Zambia

Appendix 6: List of countries by HDI

Low HDI

0.319 Congo, Rep.
0.323 Nigeria
0.349 Chad
0.355 Central African Republic
0.367 Burkina Faso
0.373 Ethiopia
0.38 Guinea-Bissau
0.381 Burundi
0.393 Madagascar
0.398 Mauritania
0.401 Guyana
0.406 Malaysia
0.409 Fiji
0.439 Cote d'Ivoire
0.44 Georgia
0.452 Djibouti
0.453 Sri Lanka
0.46 Trinidad and Tobago
0.462 Honduras
0.463 Suriname
0.464 Thailand
0.467 Benin
0.472 Liberia
0.472 Ukraine
0.475 Mauritius
0.479 Comoros
0.479 Paraguay
0.483 Serbia
0.484 Zambia
0.492 Pakistan
0.493 Cambodia
0.494 Malawi
0.504 Angola
0.514 Namibia
0.522 Kyrgyz Republic
0.526 Panama
0.527 Nicaragua
0.527 Syrian Arab Republic
0.539 Bangladesh
0.543 Senegal
0.549 Lesotho

Medium HDI

0.565 Congo, Dem. Rep.
0.569 Bhutan
0.57 Indonesia
0.571 Cabo Verde
0.596 Tanzania
0.603 Mozambique
0.604 Niger
0.606 Togo
0.61 Nepal
0.612 India
0.613 Guinea
0.614 Lao PDR
0.617 Venezuela, RB
0.622 Cameroon
0.626 Haiti
0.627 Moldova
0.629 Yemen, Rep.
0.638 Jamaica
0.638 St. Lucia
0.651 Rwanda
0.652 Mongolia
0.658 Bolivia
0.662 Gambia, The
0.662 Tajikistan
0.669 Peru
0.671 Iran
0.671 Morocco
0.672 Botswana
0.678 El Salvador
0.687 Uganda
0.688 Mali
0.691 Ecuador
0.698 Swaziland

High HDI

0.701 China
0.701 Egypt, Arab Rep.
0.706 Colombia
0.708 Albania
0.709 Algeria
0.712 Jordan
0.714 Belize
0.715 Macedonia, FYR
0.715 Turkey
0.717 Dominican Republic
0.717 Sao Tome and Principe
0.72 Armenia
0.721 Gabon
0.722 Philippines
0.725 Iraq
0.726 Bosnia and Herzegovina
0.728 Timor-Leste
0.733 Ghana
0.736 Sudan
0.738 Turkmenistan
0.739 Brazil
0.743 Azerbaijan
0.743 Seychelles
0.746 Guatemala
0.747 Kenya
0.75 Costa Rica
0.753 Mexico
0.759 Papua New Guinea
0.759 Vietnam
0.763 Sierra Leone
0.764 Tunisia
0.766 Maldives
0.773 Uruguay
0.799 Argentina