Research Paper

The Role of Education and Health in Poverty Alleviation
A Cross Country Analysis

ABSTRACT

This research is an attempt to explore; does the overall education and health situation of a country have a considerable impact on poverty magnitude? It also tries to find out the level of efficiency of selected countries to utilise education and health expenditures. This study uses data of 40 developing countries for the period of 1999-2007 and Data Envelopment Analysis (DEA) for empirical estimation. The study concludes three key findings. First, in contrast to trickle-down theory, achieving decent or high income growth rates do not ensure poverty reduction at similar pace. Second, improvements in educational and health outcomes are strongly and negatively associated with poverty incidence. However, educational improvements appear to be more strongly correlated with decline in poverty headcounts as compared to health improvements. Third, efficient use of public expenditures on education and health not only results in improved educational and health outcomes, but it also permits a reduction in poverty. Thus, the study provides evidence in support of poverty reduction through improved education and health status.

Keywords: *Education, Health, Income, Income Distribution, Poverty Alleviation, Data Envelopment Analysis*

1. INTRODUCTION

In the literature 'poverty' has been considered as one of the most important problems of developing countries. In fact poverty is a complicated, multidimensional and greatly discussed issue throughout the world. There are many definitions of poverty[1]. According to the World Bank (2000) 'poverty is pronounced deprivation in wellbeing'. Sen (1987) argues that wellbeing comes from capability to function. Poverty arises when people lack key capabilities of having adequate income, education and health to fulfil basic human needs. However, irrespective of semantic differences, by all definitions poverty is a despondent and miserable situation. Poor of every society experience the lowest utility band of that society. The biggest obstacle in improving the living standard of a person is poverty.

Objective poverty can be classified into relative and absolute poverty. Relative poverty views poverty as socially defined, hence relative poverty is a measure of income inequality (World Bank, 2011). One of the most common measures of relative poverty is Gini coefficient, which is an aggregate inequality measure and can vary from 0 (perfect equality) to 1 (perfect inequality). Absolute poverty is defined as "a condition characterised by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information" (UNO, 1995). The extent of absolute poverty can be measured by the number of people (poverty headcount) as a fraction of total population who are unable to command sufficient resources to satisfy basic needs and who live below a specified minimum level of real income usually known as poverty line. The World Bank defined the new international poverty line as $1.25 a day for 2005, equivalent to $1.00 a day in 1996 US$ prices (Ravallion et al, 2008).

Poverty has been a continuous part of every society although with a difference in its incidence. Available literature on poverty indicates that high poverty rates can disturb the development process of a country in a number of ways. "No society can surely be flourishing and

[1] *For various definitions of subjective and objective poverty see Hagenaars & de Vos (1988); UNDP (2006). This study deals with the concept of objective poverty.*

happy, of which by far the greater part of the numbers are poor and miserable" (Adam Smith 1776). Focus given towards poverty in recent decades by global bodies, such as the World Bank and United Nations Organisation, shows the grimness of this issue. At the Millennium Summit (2000) a Millennium Development Goal (MDG) was setup by the World Bank and United Nations Organisation to halve the absolute poverty till 2015 from its level of 1990. In the World Development Report of 1970s accumulation of physical capital was focused more to reduce poverty as compared to improvement in education and health. However, World Development Reports 1980s and 1990s uttered that improvements in health and education are important to promote growth in the incomes of poor people.

A reduction in poverty figures is commonly considered as a progress measure for developing countries. According to the World Bank (2008) anti-poverty programs are effectively resulting decline in poverty level bringing absolute poverty at half of the level in 1990 as set by MDG. However, there are many serious concerns regarding this claim of success. For example, the achievement in poverty alleviation is not homogeneous throughout the world and elimination of widespread poverty is still a tough goal to achieve for many countries. Latest available estimates of the World Bank about poverty till 2005 reveal that about 25% of population is extremely poor around the world. One out of each four people is poor on the globe.

Above stated overall figure describes only a part of the situation of poverty in the world. Rate of poverty reduction is not equal across developing countries. Some countries, such as China, Vietnam and Malaysia in pacific region, experienced high rates of poverty reduction in the recent past while many countries, specifically in sub-Saharan Africa and South Asia, were unable to practice a considerable decline in poverty indices. Moreover, poverty reduction rates were also not constant for many countries during last decade (World Bank, 2004). These differences of poverty alleviation rates among countries or within country over time could be the results of different factors beyond income growth affecting poverty indices. Investment in human development is one of the primary economic factors affecting poverty[2]. Thus, empirical investigation about this factor in context of poverty alleviation is indispensable.

Most of the time policy makers follow the goal of higher per capita income or reduction of income inequality to achieve the objective of poverty alleviation. However, education level and health of the earning person in household is an important factor for poverty risk (risk of being or becoming poor) not only for himself/herself but also to his/her family. As better education and health may affect the earning of a person positively, therefore estimates of educational and health related variables will be of much use for anti-poverty policy perspective. The prime intention behind this study is to explore, does the overall education and health situation of a country have a considerable impact on poverty magnitude?

Thus, the study will test the following hypotheses:

1. Income growth affects the incidence of poverty
2. Improvements in education and health reduce poverty
3. Education is more effective than health to reduce poverty or vice versa.
4. Efficient use of public expenditures on education and health leads to poverty reduction

This study is based on both theoretical discussion as well as empirical analysis. The study is distinctive because it investigates education and health as determinants of poverty in addition to the conventional income based determinants. An effective and less expensive policy for poverty eradication is crucial as public resources are not unlimited. Ascertaining the efficiency of different countries to combat poverty will help us to identify the key factor in poverty reduction. These findings will also help us to come forward with appropriate policy recommendations.

2. CONCEPT OF POVERTY

In reality there is no common definition of poverty for which everyone agrees. Although definitions differ on what has to be considered as basic human needs, yet central meaning of

[2] *Various other factors, such as uneven distribution of assets and income, lack of business and job opportunities and uneven social relations, may affect the incidence of poverty in relative and absolute terms. However, this study primarily focuses on human development as a determinant of poverty.*

poverty in all the definitions revolves around the "lack of fulfilment of basic needs". A combination of wide range of aspects and situations of life together constitutes poverty (Mikkelsen, 2005). Poverty has many dimensions, for some it is purely an economic matter, for others it has social aspects too. Social point of view can be further divided into sub categories, for example, political and psychological poverty, etc. Sen's work (1992, 2001) widened the view of poverty beyond financial deprivation. Lack of education and poor health can limit capabilities of individuals. Hence, people not enjoying education or health are to be considered as poor.

Even within the economic notion, ideas of absolute and relative poverty exist. From social point of view it is implicit that poverty is lack of resources, lack of access to education and health care, lack of access to clean drinking water, un-fulfilment of needs and little or no opinionated representation. On the other hand economic poverty means having no or few financial resources to fulfil basic requirements of daily life. It is a difficult task to quantify social aspects of poverty for measurement purposes. Therefore, economic measure of poverty is used frequently for empirical research.

Ravallion (2003) explained how different measures or variables used for poverty can lead to dissimilar results and if the approaches are different then these results are not legitimate enough to deny opponent's findings. He also stated that even the difference of data sources can also lead to different findings due to the diverse techniques and methods used for data collection.

2.1. Income Growth and Poverty

A comprehensive meaning of income in literature is "the consumption and savings opportunity available to an entity usually expressed in monetary terms" (Barr, 2004). People are considered poor when they do not have enough income to fulfil their basic needs. Individual's income plays a key role in his/her poverty status when we consider the economic measure of poverty either absolute or relative because in both approaches the premise behind the measurement is income or expenditure. We can say that same is the case with GDP and GNP per capita of a country at aggregate level with regard to country's poverty echelon.

Impact of income growth on poverty mostly depends upon how this growth has been shared by the population of a country. If the most part of the growth is received by the rich then even high rates of growth will not reduce number of poor to large extent (Todaro and Smith, 2010). It is logical to consider that an income growth will help less to reduce poverty in the presence of higher income inequality whereas income growth will help more to reduce poverty if income inequality is lesser in the society. Similarly, if income inequality is rising as income grows then this income growth will not help the poor of that country.

Empirical studies reported mixed evidence regarding impact of income growth on poverty incidence. Some studies exhibit robust poverty reduction effect of growth while others show slightest impact of growth on poverty. Pro-growth proponents are of the view that an increase in the per capita income of a country will ultimately leads to a decrease in the number of poor by increasing the income of individuals and vice versa. It is a familiar notion in literature that higher growth rates of per capita income ultimately leads to poverty reduction. On the other hand it is also a view that observed per capita income growth rates are not entirely capable of achieving the goal of poverty alleviation. Growth can be anti-poor or pro-poor[3]. It depends on the capacity of poor people to participate in and benefit from growth (World Bank, 2005). For this reason some of the pro-growth proponents consider growth as a necessary condition but not the sufficient condition for poverty alleviation. Generally, growth rate of per capita income has been given a central objective status in poverty reduction programs throughout the world. However, countries experienced poverty reduction through economic growth in fact focused on the productive use of labour, the only asset owned by the poor (Squire, 1993). This finding clearly supports the concept of pro-poor growth to reduce poverty.

Some studies using regression analysis suggest that there is strong association between growth rates of average living standards and rates at which absolute poverty reduces (Ravallion,

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[3] *The term pro-poor (or anti-poor) growth is used in context of economic policies to stimulate economic growth for (or against) the benefit of poor people (Ahlenius, 2006). Growth that leads to significant reduction in poverty is called as pro-poor growth and vice versa (UNO, 2000). In this study we use the concept of pro-poor and anti-poor growth in context of human development, absolute poverty and income inequality.*

and Chen 1997, Ravallion and Datt 1996, Ravallion and Datt 2002, Besley and Burgess 2003). Demery and Squire (1996) analyzed six African countries for the relationship of poverty with growth and income inequality. They found that in all the countries growth was more effectual toward incidence of poverty as compared to inequality.

On the other hand there are serious concerns whether focusing on growth promise to help the poor of country or not. Some studies show that economic growth does not guarantee adequate reduction in poverty as in case of some countries it has been observed. The World Bank's intervention to reform agriculture in the Philippines has resulted in anti-poor outcome even the rate of economic growth was satisfactory in the Philippines during that period (Borras et al. 2007). Gunetilleke (2000) reported that in Sri Lanka poverty reduction rate was below than expected at the observed rate of economic growth. These findings ask for careful analysis of poverty and growth.

A recent work of Duclos and Verdier-Chouchane (2010) demonstrated that due to different patterns of income inequality, growth in South Africa has been anti-poor relatively over the period of 1995-2005. On the contrary, growth was absolutely pro-poor in Mauritius over the period 2001-2006. Empirical evidence suggests that experiences of growth and poverty reduction vary from country to country. The above mentioned literature shows that income growth may or may not reduce incidence of poverty at same or adequate rate. The role of economic growth in poverty alleviation depends upon how much anti-/pro-poor the growth is?

2.2. Education and Poverty

People having knowledge and skills are commonly known as human capital and basic source for acquisition of human capital is formal education. According to human capital theory, education is an investment decision made by individuals, which will help them in future to get returns. In literature it has been argued that economic role of education or human capital is to foster the economic growth by increasing income of masses. Empirical evidences exist in favour of the view that higher the human capital, higher will be the growth rate of income (Becker et al, 1990; De Gregorio et al, 1992; Becker, 2009). This is also correct for an individual who earns comparatively more than his/her fellow being who is relatively less educated. Education enhances individuals' economic security (Hannum & Buchmann, 2005) Different rates of return for different schooling levels have been calculated throughout the world. These rates vary from region to region depending upon various factors[4].

O'Neill (1995) investigated the relationship between education and income inequality by decomposing income due to education, return to education and a residual component. He concluded that in developed countries convergence in educational attainment resulted in a reduction in income inequality. Tsai (2006) examined the economic and non-economic determinants of poverty. He analysed various theories of poverty and tested empirical data of 97 developing countries. The empirical outcomes revealed that income level, population growth and secondary schooling opportunity are significant predictors of poverty reduction. Goh et al (2009) investigated the effect of attained education on poverty. Their finding was that education played an increasingly important role in household income determination for both urban and rural areas. Income gaps have increased between households with more and less human capital endowment. Sylwester (2000) used data of many countries and showed fairly similar results that public education expenditures appear to be associated with a decrease in the level of income inequality.

According to Berg (2008) "this connection between education and poverty works through three mechanisms. Firstly, more educated people earn more. Secondly, more (and especially better quality) education improves economic growth, economic opportunities and incomes. Thirdly, education brings wider social benefits that improve economic development and especially the situation of the poor, such as lower fertility, improved health care of children and greater participation of women in the labor force". Education influences both, the ability of the individuals to earn income and their decisions which increase the probability of success in lifetime. Thus, direct and indirect impacts of education on poverty can be illustrated as shown in figure 1.

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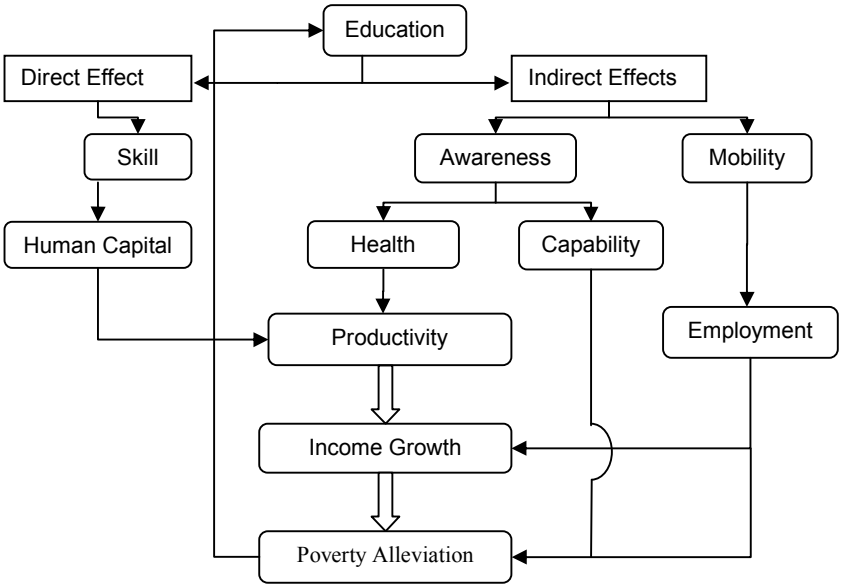
[4] *In his introduction to the* Wealth of Nations*, Adam Smith (1776, p. 1) states that the proportion between the annual produce of a nation and the number of people who are to consume that produce depends on "the skill, dexterity, and judgment with which its labour is generally applied."*

Figure 1: Impact of Education on Poverty Alleviation[5]



As discussed previously education can impact poverty in many ways other than improving human capital. There are a number of externalities of education and these can help poor to get out of poverty status. For example, reading ability can help to understand instructions on a medicine or on a fertilizer bag or even a general health care notice in newspaper. Obviously, instructions on medicine will help to be healthy and instruction on fertilizer bag can help to increase output of an agriculture farm. Similarly, a basic analytical skill may help a person to compare different price packages in market and to prefer one according to his/her need. An educated father prefers education for its next generation due to its realized importance (Harper, Marcus and Moore, 2003). These are few examples out of many externalities of education and there are many more externalities which have been discussed widely in the literature on human capital. It can be concluded that income effect and externalities of education help people to improve their life patterns in a number of ways and then these improved patterns help them to get rid of poverty. These conclusions suggest "education" as a key variable in poverty alleviation.

2.3. Health and Poverty

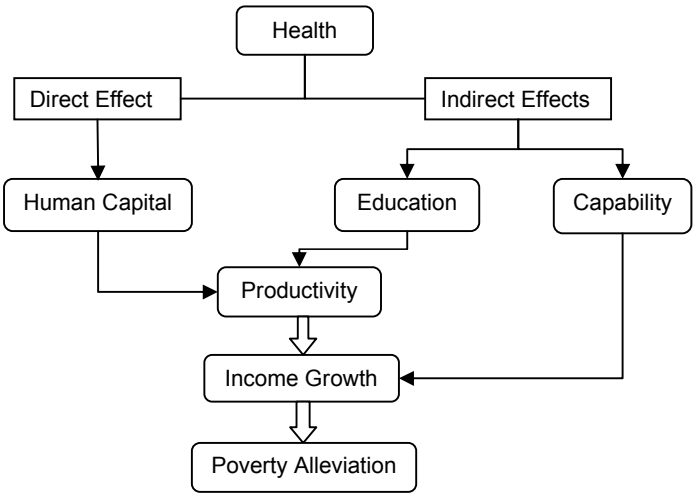
According to World Health Organization (WHO) health is defined as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity"[6]. In general, health is the level of functional and metabolic efficiency of human being. This efficiency is sometimes measured in terms of health condition of human being like Body Mass Index (BMI). However, for health related analysis at country or global level different types of health measures are used in empirical studies, e.g. life expectancy, mortality rates, etc.

Better health is supposed to increase working and intellectual capabilities of people. Health is a vital element of human capital and is considered as requirement for increase in productivity of labour (Knapp, 2007; Burton, 2010). Physical capability to do work depends upon individual's health status. Healthy workers are more productive and they can work for more hours of work per day as compared to unhealthy workers. This higher productivity and ability to do more work help individuals to earn more than others. Healthy people usually live longer than the sick people. It means they will have more life time to generate income. Bloom et al (2004) examined the relationship between health and income growth. They concluded that good health has a positive, sizable and statistically significant effect on aggregate income.

[5] *Figure 1 has been taken from Janjua and Kamal (2011).*
[6] *Official Records of the World Health Organization, no. 2, p. 100.*

Todaro and Smith (2010) argued that improved health also affects school performance and healthy people can benefit society in many ways. Healthy children are usually better in learning and they do not need to be absent from school or colleges due to sickness, which results growth and improvement in human capital of society. Gunetilleke (2000) stated that difficulties in accessing education and health facilities hindered people to gain advantages of improved education and health. Access of poor to education and health was one of his suggested priorities to reduce poverty effectively. Lawson (2004) found that ill health and long term sickness is associated with people moving into poverty. He further found that ill health is also causing reductions in assets like land and livestock because poor have to sell their assets to face ill health. Godlonton and Keswell (2004) used body mass index as proxy of health and found that family with more unhealthy (underweight) individuals and household heads are likely to be income poor. They also stated that these findings are invariant to the choice of poverty line. In literature of health economics a view has been developed that weak health conditions limit the capacity to do work. In addition, low health conditions in itself are considered as an aspect of poverty in broader concept of poverty. Above discussion suggests that improved health can impact earning of individuals positively through different ways and consequently help them to escape from poverty. Therefore, health is an important asset, especially for poor people as most of poor people can earn only by providing labour. Thus, health is another important factor affecting the income of poor. Keeping in view the above literature we can illustrate different health attributes, which can affect poverty, as given in figure 2.

Figure 2: Impact of Health on Poverty Alleviation



Squire (1993), by analysing data of 31 countries for 1965-85, drew three conclusions; 1) Economic growth should be encouraged to induce productive use of labour so that poor can earn to get rid of poverty, 2) Public spending is an important source to improve health and education attainment of poor and 3) Provision of subsidized social services is better than direct cash transfer. Investment in social sectors, such as education and health, can greatly contribute in improving education and health status of a country. Baldacci et al (1995) used panel data of 118 developing countries from 1971 to 2000 and concluded that both education and health spending have a positive and significant impact on education and health capital.

Wilhelm and Fiestas (2005) examined the linkage between public spending and poverty reduction by analysing data of 14 countries for 1990s and concluded that an increase in public spending in education and health, agriculture and infrastructure has a positive effect on growth and an even larger effect on poverty reduction. Chemingui (2007) developed a GCE model for Yemen economy to assess the impact of public spending for social sector on poverty reduction. By using real data from 1991-2002 the author simulated alternative scenario for 2016 and concluded that public spending targeted more toward improving health and education services generates more economic growth and thereby reduces the poverty level.

3. CONCEPTUAL FRAMEWORK

As discussed before, claims exist in favor of both theories that economic growth helps the poor and may not help the poor to overcome the problem of poverty. Another important concern is that whether the acquired growth is benefiting the poor or not. Same growth rate of per capita income can impact poverty to different extent in different countries depending on who is ultimate gainer of economic growth. If economic growth is anti-poor then it will not have a considerable impact on poverty reduction no matter how high is the rate of growth. On the other side a pro-poor growth can effectively reduce the poverty even if rate of growth is not very high.

Governments spend their revenues on both education and health as a part of public expenditure. Public spending on education and health reflects that how much a government is emphasizing on human development within a country. However, governments cannot increase public spending to an unlimited level as the revenue resources of governments are scarce and choices have to be made to use these resources efficiently. In this scenario, along with the "amount" of reserved funds for public spending the "efficient use" of funds is equally important.

3.1. Universe of the Study

World Bank has classified all the world countries on the basis of their incomes in four groups, namely low income, lower middle income, upper middle income and high income countries. This study includes all the countries except high income countries, because poverty is not a big issue in rich countries. Thus, a set of 40 developing countries (see appendix 1), for whom data requirements are fulfilled, is selected as a sample. Constraint of data availability restricted us to select 40 developing countries and to use data of 9 years from 1999 to 2007. Interpolation and extrapolation method was adopted to generate missing values. All DEA calculations were done by taking averages of both input variables and by considering total progress of all output variables. Rescaling of negative outputs was also done to convert them to minimum positive outputs, as outputs were necessary to be positive.

3.2. Selection of Variables

This study includes the variables of per capita GNP growth, poverty headcount, Gini coefficient, net enrollments, life expectancy as well as education and health expenditure.

We select per capita GNP growth because poverty headcount calculates national individuals below poverty line. Moreover, GNP includes income from remittances many poor families live on.

The basic concept behind absolute poverty measures is the "command over commodities" and these commodities are similar in all surveys as supervised by the World Bank. For cross country analysis same reference poverty line will produce better results at aggregate level. Poverty Headcount (PHC) measure considers the number of poor as a ratio of total population. This common headcount method is based on income/expenditure of individuals and both are commonly used for the measurement of absolute poverty.

Value of Gini Coefficient (GINI) ranges between 0 and 1 where 0 shows perfectly equal and 1 shows perfectly unequal income distribution. The higher the value of Gini coefficient the more is income inequality. Although Gini coefficient is one dimensional measure of income distribution, yet it represents an effective mean of looking at the relationship between inequality and poverty for a broad range of countries (Besley and Burgess, 2003)

For educational attainment we do not use literacy rates because only literacy (capability to read and write) will not help a person to earn enough income to meet his/her essential expenditures. Thus, for this purpose we select net enrolment rates. The advantage of using net enrollment rates over the gross enrollment rates is that the former does not overstate the numbers as in case of later due to repeaters and replacements. In this study we use net secondary enrolment rates (NES) because secondary education provides more job and higher wage opportunities than primary education.

Life expectancy (LE) measure shows expected number of years of life at birth. Life time earning of a person depends upon average earning rate and total working life. Long life probably allows a person to increase his/her working life which increases total life income of that person. This reasoning suggests life expectancy measure as more suitable measure as compared to other health measures like infant mortality, etc.

Government spending on social infrastructure primarily constitutes expenditure on education and health. Ratios of these expenditures to national income, or to the total government expenditure reflect how much a government laid emphasis on human development as compared to other options. Both the ratios are commonly used in empirical studies. In this study we use the ratios of education expenditure as well as health expenditure to total government expenditure.

3.3. Data Sources

Data for poverty headcount and Gini coefficient have been downloaded from the World Bank online source PovCalNet. While fetching the poverty headcount ratios from the World Bank online source, revised version of poverty line (1.25 US$ per day/person at PPP 2005) was used.

Data for per capita income, net enrollment rates, life expectancy and public spending were taken from UN data source. The source was approached for statistics of net enrollment rates because UNESCO had collected the data regarding net enrollment rates by standardizing the years of education for secondary level which is advantageous for cross country comparison.

Data for poverty headcount and Gini coefficient was available at frequency of three years. For data interpolation average annual growth was calculated by using two nearest edge values whereas for extrapolation overall average annual growth was calculated by using all available values. For the variable of per capita income there were no missing values. Enrollment rates of secondary level were missing for few countries in UN data source. Among some of these countries only one or two time series units of data were missing. In no case a country was selected having more than four missing data points in complete time series of any variable.

Data for each variable was taken from the same single source across the time series as well as cross-section units. It was necessary because different data sources may have used different techniques and tools for data collection. Moreover, maximum available data for both time series and cross-section units was collected to minimize the artificial effect of interpolation or extrapolation implements.

3.4. Methods of Estimation

Previous studies estimate the impact of economic growth on the incidence of poverty by using various regression analyses. The studies are either limited in scope due to sectoral analysis (Ravallion and Datt 1996; Ravallion and Chen, 1997) or they use aggregate, cross-country data to estimate the relationship between growth, inequality and poverty (Besley and Burgess, 2003; Dollar and Kraay, 2004) which is extremely difficult to interpret because results are likely to be sensitive to the choice of specification. Moreover, there is a possibility of simultaneity bias between poverty and inequality because both move together in same direction due to income.

Recent literature emphasizes the role of government and institutions which is not adequately considered in empirical studies (Ames et al, 2001; Tebaldi and Mohan, 2011). Some studies are carried out to examine the impact of public spending on the incidence of poverty through the application of GCE model (e.g. Chemingui, 2007). These studies are based on simulation of alternative future scenarios with the help of historical data and by manipulating certain policy variables, such as public spending for social sectors. However, the efficiency of public spending for growth and poverty reduction depends on many factors, such as targeting, institutional quality, provision of complementary goods and services, role of non-governmental organizations and private sector, etc. The effect of such factors cannot be captured through simulation studies.

Economic literature indicates positive correlation between public spending on human capital and economic growth (e.g. Moreno-Dodson, 2008) as well as between improvement in

human capital and poverty reduction (e.g. Winters and Chiodi, 2011). Investments in health and education are now considered by global entities as important means to reduce number of poor. It makes sense to assume that in a country choice of allocation of resources for education and health will possibly impact poverty trends.

Allocation of resources toward any policy of poverty reduction requires at least two tier empirical understanding. One, how much education and health improvements are correlated with poverty alleviation? Second, how efficiently a country uses its previously allocated funds in both of these sectors? The empirical understanding will help governments to direct their limited resources toward more efficient and effective sectors to achieve rapid poverty reduction rates. Governments usually spend on both sectors to achieve the larger social development goal. For example, governments may have the objectives of higher net enrollments as well as improved health of masses. However, indirectly poverty reduction or improved income distribution could be one of the social goals of government behind these public spending.

Let us assume that as inputs (I) a country has two expenditures, i.e. education expenditure and health expenditure.

In function form it can be written as

Inputs (I) = {education expenditure, health expenditure} … (1)

We also assume that as outputs (O) the country has four objectives which can be written as

Outputs (O) = {reduction in absolute poverty, reduction in income inequality, increased enrollments, increased life expectancy} … (2)

According to broader concept of poverty these four objectives can be considered as anti-poverty objectives[7].

In this study a non-parametric method named as Data Envelopment Analysis (DEA) with constant return to scale (CRS) has been used to obtain results[8]. The basic model of DEA is developed by Charnes, Cooper & Rhodes (1978). DEA measures relative efficiency by comparing all Decision Making Units (DMUs) with "the best" DMU. It is assumed that countries want to maximize the output at a given input cost, i.e. education and health expenditure. In our case governments are assumed as DMUs which take decisions regarding how much funds should they allocate to spend on education and health. DEA will help us to identify the most efficient, relative efficient and least efficient countries by using above assumed input/output variables[9].

4. DATA ANALYSIS AND RESULTS

4.1. Exploratory Data Analysis

We start our analysis of selected countries on growth and poverty. The descriptive statistics for our concerned variables are given in Table 1. It shows central tendencies of average growth rate (AG), average change in poverty headcount (ACP) and average change in income inequality (ACG) of 40 developing countries between 1999 and 2007.

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[7] *It is assumed that the set of output variables do not strictly define poverty status of a country. However, it's a desired set of outputs as any improvement in these outputs will help to reduce poverty, either commonly known economic poverty or broadly defined poverty.*

[8] *DEA is executed by using online DEA software available at http://www.deaos.com/*

[9] *DEA is used to measure the productive efficiency of maximizing output out of a given input. It can handle multiple inputs and outputs with different units. However, it does not provide detailed analysis about the dynamics of efficiency.*

Table 1: Descriptive Statistics of Growth and Poverty (1999-2007)

	AG	ACP	ACG
Mean	6.46	-0.69	-0.06
Median	5.77	-0.51	0.02
Maximum	15.86	2.63	0.93
Minimum	1.99	-4.17	-3.19
Std. Dev.	2.96	1.21	0.67
Skewness	1.20	-0.64	-2.58
Kurtosis	4.29	5.05	13.17
Jarque-Bera	12.50	9.82	217.26
Probability	0.00	0.00	0.00

AG: Average Growth ACP: Average Change in Poverty Headcount ACG: Average Change in GINI

The statistics reflect improvement in average growth and reduction in absolute and relative poverty with mean values of 6.46, -0.69 and -0.06, respectively.

Figure 3 shows the average trend of incidence of poverty for 40 selected countries at aggregate level during the period of 1999-2007[10]. It is observed that poverty has been declining at the rate little higher than half percent per year. As population of world is also increasing continuously therefore this progress cannot be considered as "satisfactory".

Figure 3: Average Trend in Poverty (40 countries, 9 years)

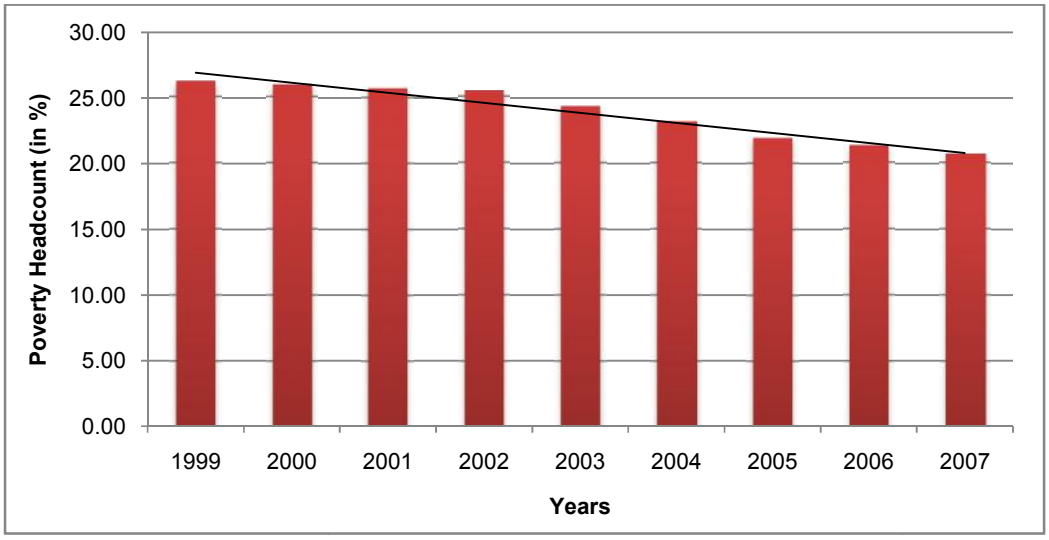
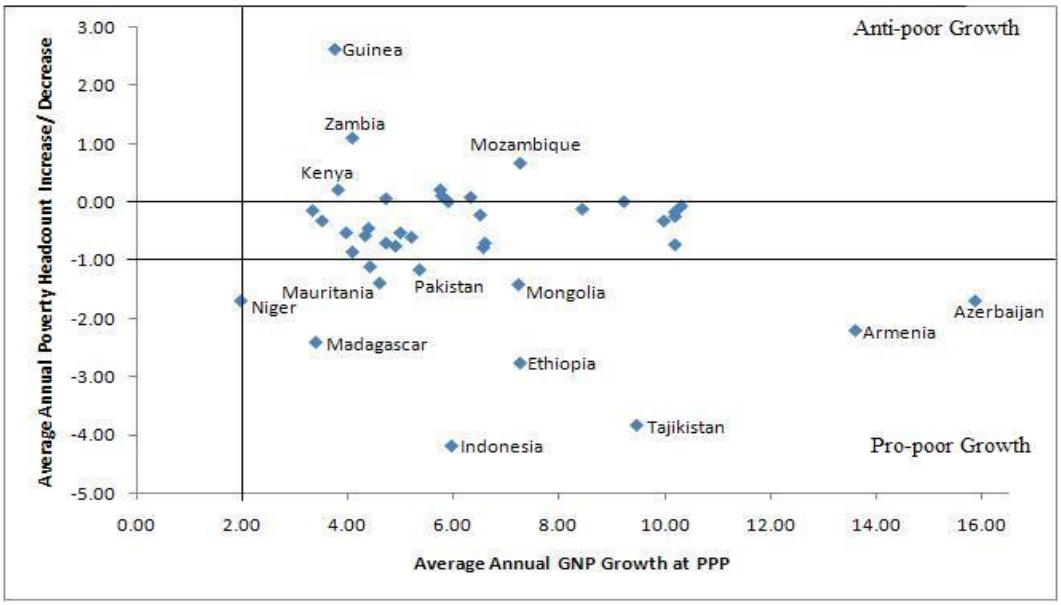


Figure 4 places 40 countries on their respective positions according to their average GNP per capita growth and average increase or decrease in poverty incidence over the period of 9 years (1999-2007). These pro-poor and anti-poor classifications and ranks of countries provide information about what percentage of absolute poor is getting or not getting benefit from economic growth.

[10] *For Box plot graph of poverty headcount data see Appendix 4.*

Figure 4: Groups of Countries with Pro-/Anti-Poor Growth



In Figure 4, countries which are above the upper horizontal line experienced increase in poverty on average in 9 years period. Countries which are below the lower horizontal line experienced a decrease of more than one percent on average in poverty incidence. We can see that all the selected countries have more than 2 percent average GNP per capita growth. However, we can classify countries into three groups. Through this classification we can identify how income growth in each group has affected the poor. In first group of countries income growth was anti-poor and in second group of countries income growth was pro-poor[11]. In third group of countries income growth turned more toward rich and less toward poor as it did not help one percent of the poor. We can also observe that most of the countries are in this third group.

Even within specified classification we can rank countries from most pro-poor to least pro-poor and from least anti-poor to most anti-poor. For example, Niger experienced much more pro-poor income growth as compared to Azerbaijan as in both countries poverty fell on average 1.70% per year despite the large difference between growth rates of both countries. In our set of 40 countries Indonesia is starkest example with average poverty reduction of 4.20% per year. On the other side Guinea was worst as incidence of poverty increased on average of 2.64% per year even the growth rate was 3.78 during that period. In Pakistan average growth rates were decent and average per year poverty reduction was also moderate. We can categorize Pakistan's income growth as fairly pro-poor income growth.

Figure 5 provides even more precise information regarding the country's pro-/anti-poor income growth status. Figure 5 is obtained from ratio of average poverty reduction to average growth rate. Figure 4 and 5 enable us to understand that only having high growth rates do not ensure sufficient poverty reductions. Although economic growth rate in Niger was hardly fair even then poor of Niger benefited from it significantly. On the lowest side growth rate in Guinea was fair. However, this income growth worsened the condition of poor in Guinea instead of serving them. Thus, our results confirm the conclusions of World Bank (2005) as well as Todaro and Smith (2010) that economic growth is not a sufficient condition to reduce poverty.

As stated before, ratio of education and health expenditure to the total government expenditure tells us how much a country is focusing on its human capital to increase economic growth and reduce poverty.

Following table illustrates the descriptive statistics of selected variables:

[11] *When any country experiences at least one percent reduction on average in poverty incidence then we assume its growth as pro-poor growth. On the other hand if any country's poverty incidence is rising on average then we consider its growth as anti-poor growth.*

Table 2: Descriptive Statistics of Public Spending, Human Capital and Poverty (1999-2007)

	EE	HE	NES	LE	PHC	GINI
Mean	4.37	5.41	34.24	25.94	30.52	25.51
Median	4.13	5.63	35.31	26.33	29.12	24.84
Maximum	12.99	8.31	50.61	28.36	58.40	50.54
Minimum	1.61	1.97	17.85	19.53	3.89	17.53
Std. Dev.	2.14	1.51	8.45	1.88	9.72	5.37
Skewness	1.67	-0.36	0.02	-2.24	0.64	2.58
Kurtosis	7.54	2.61	2.26	8.07	5.05	13.17
Jarque-Bera	53.09	1.15	0.90	76.39	9.82	217.26
Probability	0.00	0.56	0.63	0.00	0.00	0.00

EE: Education Expenditure **HE:** Health Expenditure **NES:** Net Secondary Enrolment **LE:** Life Expectancy **PHC:** Poverty Headcount **Gini:** Gini Coefficient

The table shows that government expenditure on education and health on the average of these forty countries was 4.37 and 5.41 percent of their total public spending per year during the period from 1999 to 2007. The average values of net secondary enrolment and life expectancy at birth were 34.24 and 25.94, respectively. Similarly, the average values of poverty headcount and income inequality were 30.52 and 25.51, respectively. Large value of standard deviation of poverty headcount and net secondary enrolment shows that there was a considerable variation in these variables among 40 countries during the above-mentioned period.

Figure 6 and 7 show education and health expenditures of all countries as a percentage of government's total expenditure. In resource allocation toward education Lesotho is on top with an average of 13% of total government spending and Cambodia is on bottom with an average of 1.6% of total government expenditure. South Africa is highest spender of health expenditure with an average of 8.31% of total government expenditure and Indonesia is lowest with an average of 1.97% of total government expenditure.

Following table shows the correlations between selected variables:

Table 3: Correlations between Selected Variables

	PHC	GINI	NES	LE
PHC	1			
GINI	0.2535 (0.0000)	1		
NES	-0.8246 (0.0000)	-0.2618 (0.0000)	1	
LE	-0.8106 (0.0000)	-0.1602 (0.0023)	0.7651 (0.0000)	1

PHC= Poverty Headcount GINI= Gini Coefficient NES= Net Secondary Enrollments LE= Life Expectancy

The strongest correlation exists between net enrollments in secondary education and poverty headcount. Negative sign indicates that an increase in net secondary enrollments is strongly associated with a decrease in incidence of poverty. Second strongest correlation exists between years of life expectancy and poverty headcount and it is also negative. Both the education and health measures are also negatively correlated with income inequality in same pattern (education more and health less correlated with negative sign). Positive correlation between poverty headcount and income inequality suggest that a rise in income inequality is positively correlated with rise in poverty headcount.

The results of correlation indicate that countries focusing their public expenditure on human development may get better results to reduce poverty through economic growth. Thus, our results match with the findings of Sylwester (2000) and Goh et al (2009) as well as Lawson (2004) and Godlonton & Keswell (2004) in context of positive impact of educational and health attainments on poverty reduction. However, the reduction in the incidence of poverty also depends on how efficiently the countries allocate resources for education and health.

Figure 5: Ranking of Countries according to Pro-/Anti-Poor Growth

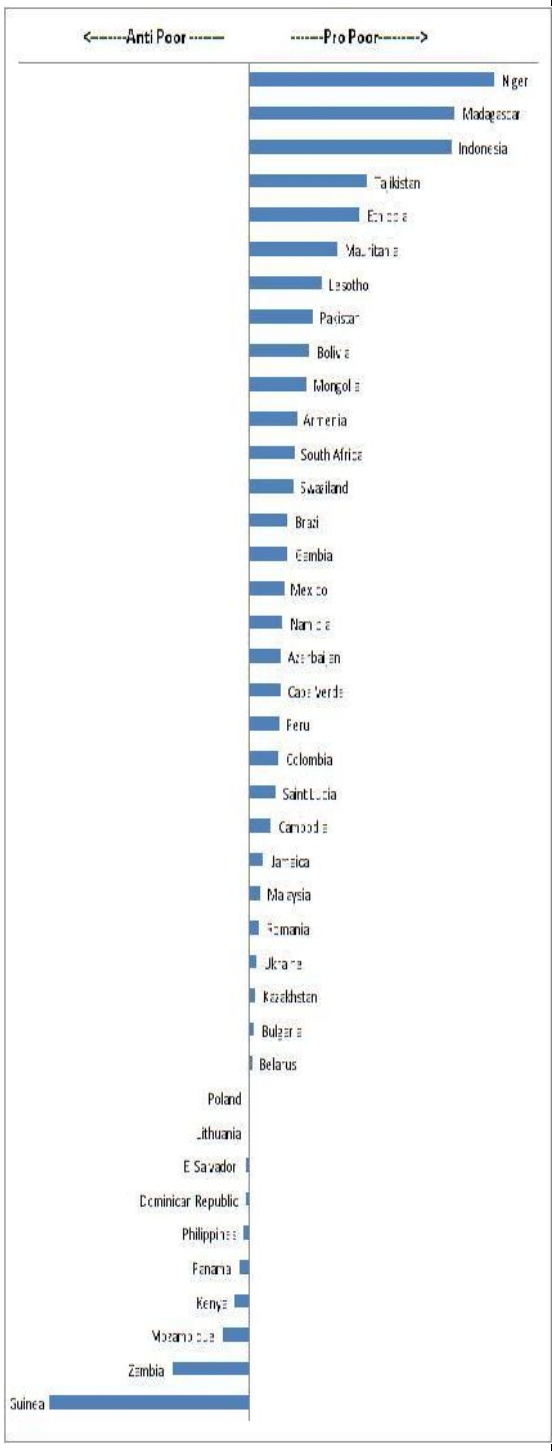
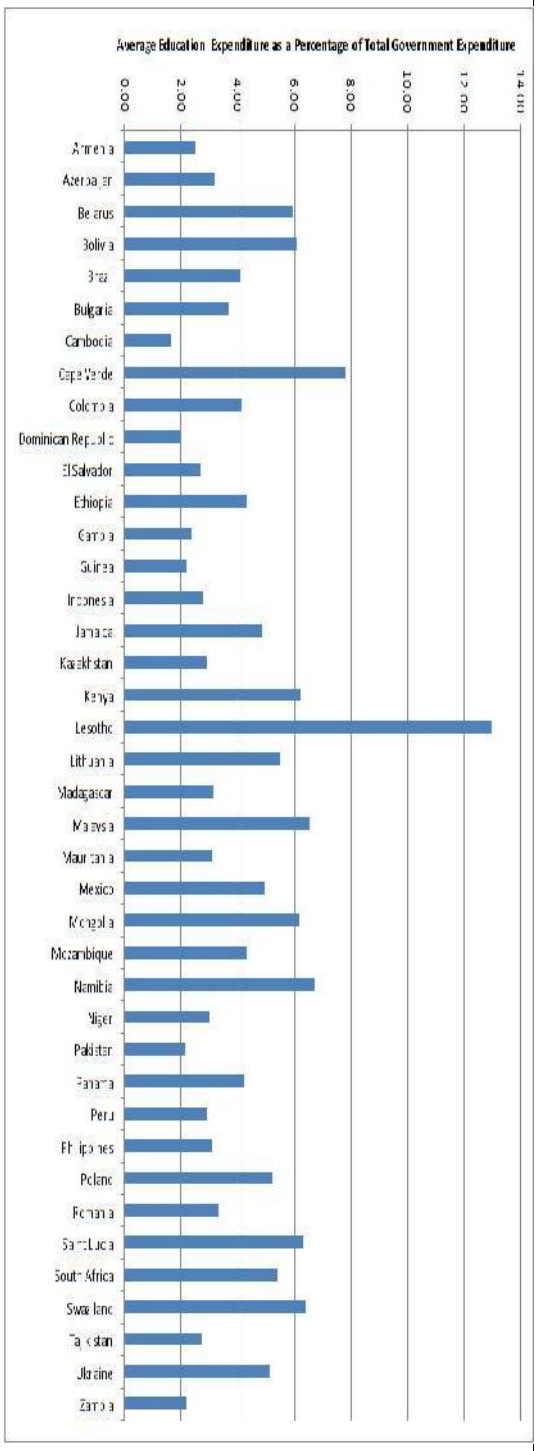


Figure 6: Education Expenditure as % of Total Government Expenditure



4.2. Data Envelopment Analysis

As stated before let us assume that a country has four goals when it decides to spend on education and health. This assumption allows us to consider following sets of inputs and outputs.

I = {education expenditure, health expenditure} … (1)

O = {reduction in absolute poverty, reduction in income inequality, increased enrollments, increased life expectancy} … (2)

Figure 8 shows the estimated efficiencies of selected set of 40 countries. On the basis of their efficiency we can classify these countries into three main groups (100% efficiency = most efficient countries, 50% to 99.9% efficiency = relative efficient countries, 0% to 49.9% efficiency = least efficient or inefficient countries).

Before going to figure 8 it is worth noting, these efficiencies are calculated by using all input and output variables[12]. A country can be most efficient if it achieves highest efficiency in any input-output combination. For example, if country 'A' is most efficient as compared to other countries in using input 'one' to produce output 'one' then it will be at efficiency level of 100%. On the other hand if a country 'B' is most efficient as compared to other countries in using input 'two' to produce output 'two' then it will also be at efficiency level of 100%.

Another important understanding is that DEA uses input-output ratios to estimate efficiencies. Therefore, it is simply possible that in absolute terms a country shows less progress and in DEA it becomes relatively more efficient as compared to a country which was similar in absolute progress. Similarly, it can also happen in opposite direction[13].

Figure 8 shows that Azerbaijan, Cambodia, Dominican Republic, Indonesia and Pakistan were the 5 most efficient countries, 17 countries were relative efficient and 18 countries were least efficient or inefficient. These results show efficiency of countries while considering all output variables.

However, we can dig out even more useful information if we do this analysis for a single output. For example, if we want to know that what is the efficiency level of a country if the government's objective was only to reduce absolute poverty? Figure 9 shows efficiency of all countries in absolute poverty reduction by using education and health expenditure as inputs. Most efficient country in absolute poverty reduction was Indonesia and most inefficient country was Guinea. 11 countries were in relative efficient category and 28 countries were least efficient to reduce incidence of poverty. Pakistan was on 5th from top in achievements against absolute poverty.

An important concern here is that why countries differ in efficiencies? It could be the case that if a country is using its education expenditure efficiently to improve educational output (net enrollments in secondary education) then this efficiency may help the country to fight well against absolute poverty. Similarly, efficient use of health expenditure to improve health indicator (life expectancy) may also help to shrink poverty.

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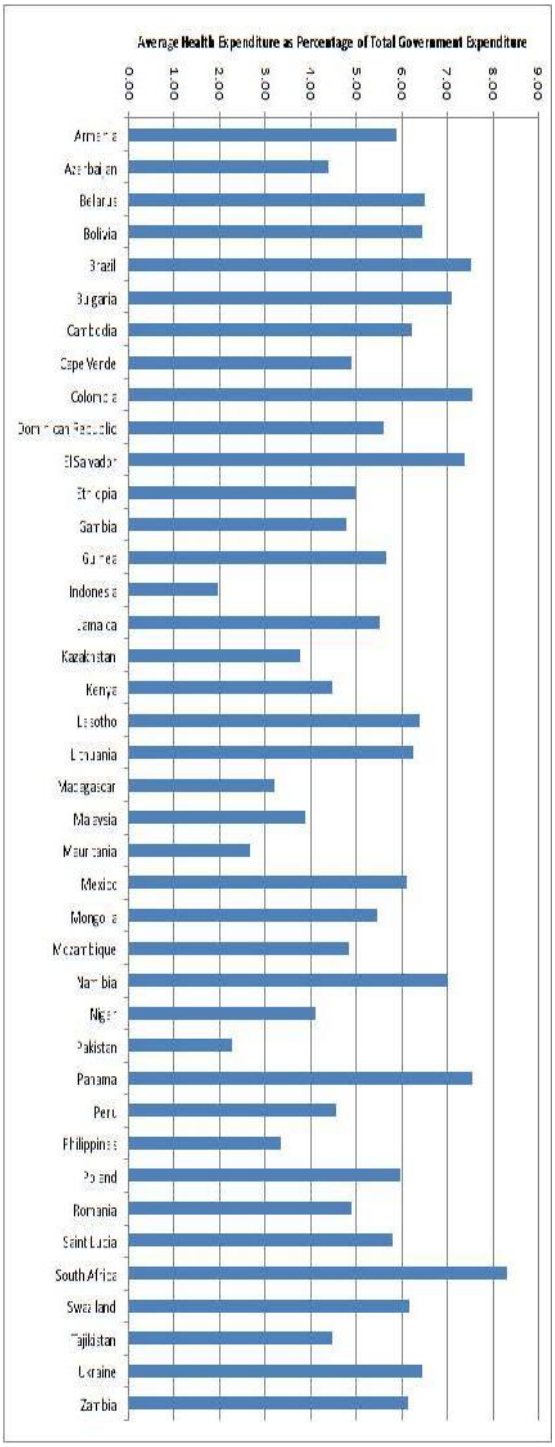
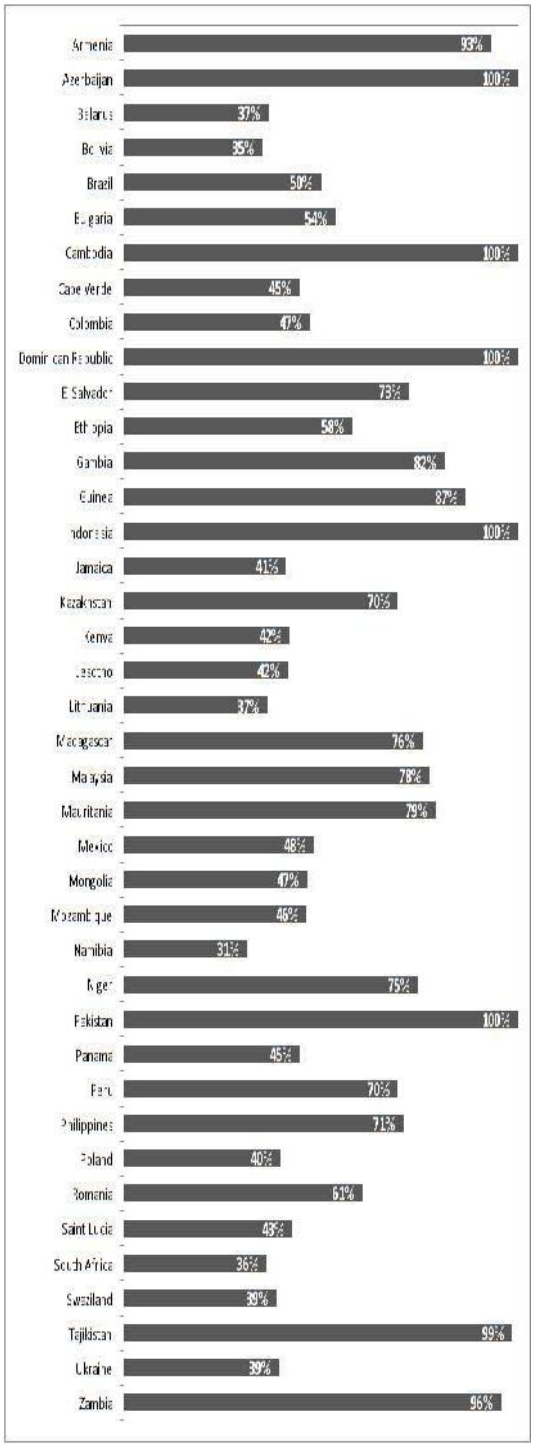
[12] *All DEA calculations were done by taking averages of both input variables and by taking total progress of all output variables. Rescaling of negative outputs was also done to convert them to minimum positive outputs, as outputs were necessary to be positive. For other efficiencies like each output separately against all inputs see appendix 2. It will provide additional help to understand figure 9.*

[13] *In our analysis results of 17 efficient countries and 5 inefficient countries match with the results of pro-/anti-poor growth. However, results of 13 inefficient countries and 5 efficient countries do not match with the results of pro-/anti-poor growth (see Appendix 5).*

Figure 7: Health Expenditure as % of Total Government Expenditure	Figure 8: Efficiency Ranking with all Inputs and all Outputs
	

It is also important to know whether efficiency in educational output (i.e. net enrollments) is more important or efficiency in health output (i.e. life expectancy) is more important. Correlations between efficiencies of Table 4 can provide us useful understanding.

Table 4: Correlations between Efficiencies of Selected Variables[14]:

Absolute Poverty, Education and Health

	Efficiency in Absolute Poverty Reduction (inputs=edu_exp, health_exp) (output=reduction in absolute poverty)
Efficiency in Education (input=edu_exp) (output=net enrollments)	0.62
Efficiency in Health (input=health_exp) (output=life expectancy)	0.59

We can see that efficiencies of absolute poverty are highly correlated with efficiencies of education and health. These correlations suggest that if a country can efficiently use its education or health expenditure to improve respective educational and health outcomes then the chances are more to experience reduction in absolute poverty. In general we can also assert that although both education and health sectors are important however, education sector plays more important role in the alleviation of absolute poverty as compared to health sector.

Similarly, we can see that efficiencies of income inequality reduction are also strongly correlated with efficiencies of education and health. These correlations suggest that if a country can efficiently use its education or health expenditure to improve respective educational and health measures then the chances are more to experience reduction in income inequality.

Table 5: Correlations between Efficiencies of Selected Variables:

Income Inequality, Education and Health

	Efficiency in Income Inequality Reduction (inputs=edu_exp, health_exp) (output=reduction in income inequality)
Efficiency in Education (input=edu_exp) (output=net enrollments)	0.71
Efficiency in Health (input=health_exp) (output=life expectancy)	0.55

We can also find the efficiency level of a country in reducing income inequality. Figure 10 shows efficiency of all countries in income inequality reduction by using education and health expenditure as inputs. Pakistan and Azerbaijan were two most efficient countries in reduction of income inequality during this period. 15 countries were relative efficient and 23 countries were least efficient in reducing income inequality.

In general we can also assert that although both education and health sectors are important however, education sector plays much more important role in reducing income inequality as compared to health sector.

[14] *It is important to note that the correlations in Table 4 and 5 are calculated on the basis of relative efficiencies and not on the basis of the original data. For details of efficiencies of all countries see appendix 2 and 3.*

Figure 9: Efficiency Ranking with all Inputs and one Output: Absolute Poverty

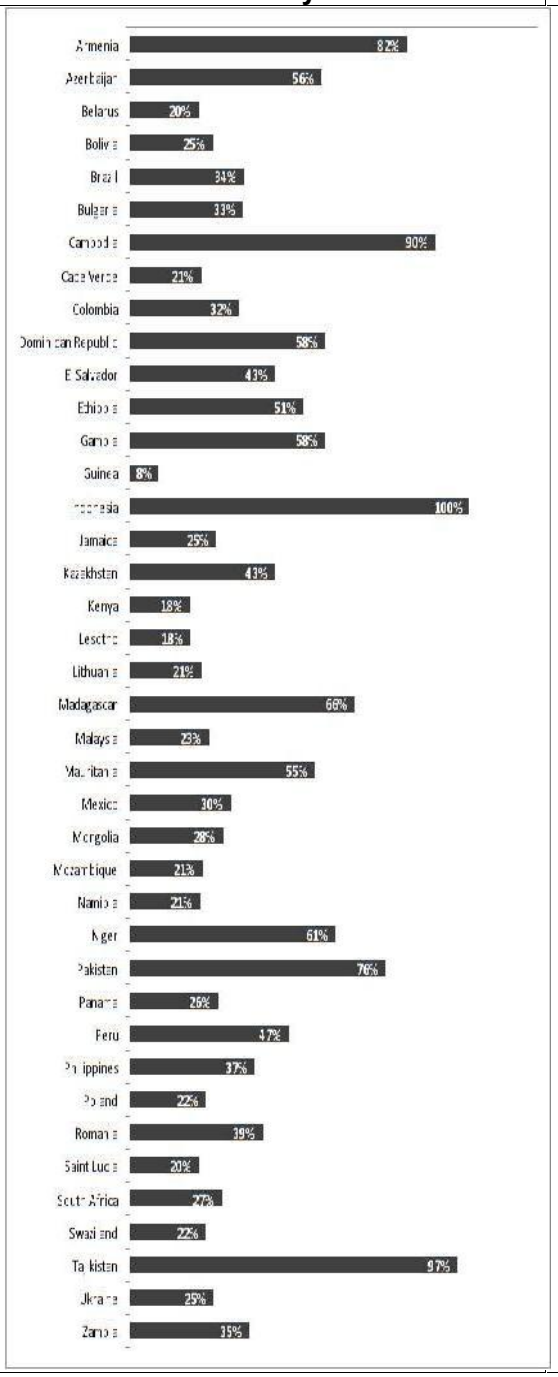
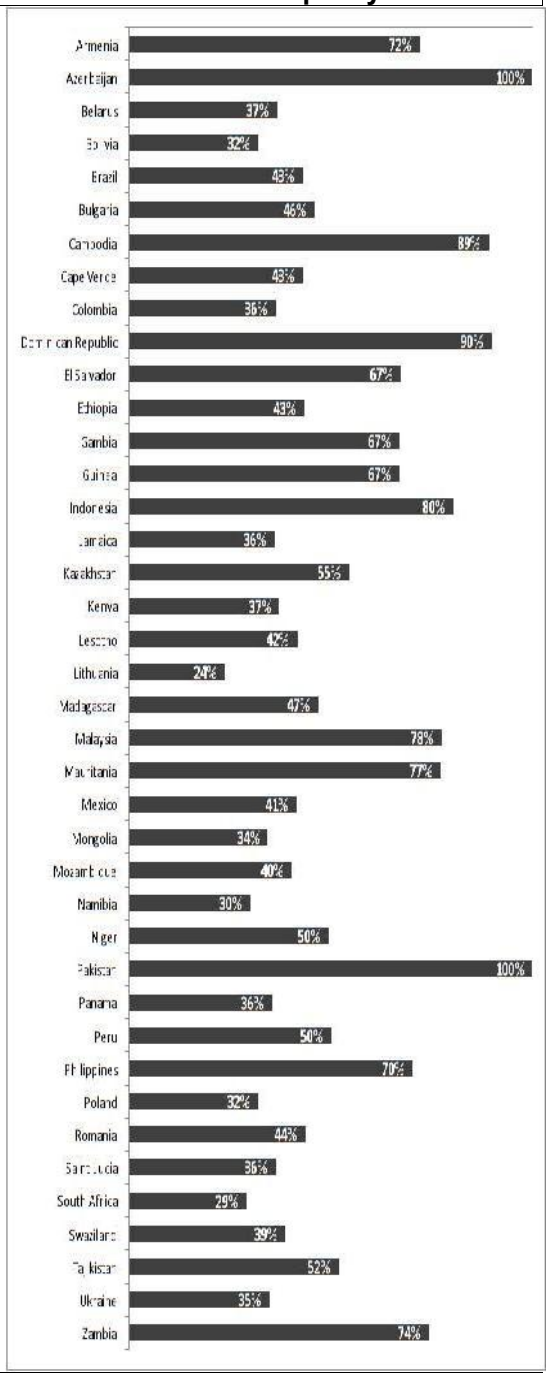


Figure 10: Efficiency Ranking with all Inputs and one Output: Income Inequality



5. CONCLUSIONS AND RECOMMENDATIONS

The results of estimations of this study enable us to draw following conclusions. First, it can be ascertained from the results that in selected 40 countries some countries experienced pro-poor income growth and in other countries income growth did not help the poor. Second, achieving decent or high growth rates of income do not ensure (as suggested in trickle-down theory) poverty reduction at similar pace. Third, improvements in educational and health outcomes are strongly and negatively associated with poverty incidence. However, educational

improvements appear to be more strongly correlated with decline in poverty headcounts as compared to health improvements. Fourth, educational and health outcomes are also negatively but moderately correlated with level of income inequality. Fifth, efficient use of public expenditures on education and health not only result in improved educational and health outcomes (net secondary enrolments and life expectancy), but it also permit a rapid poverty alleviation and improved income distribution.

Two major conclusions, that distinguish this study from the previous studies, can be drawn from above estimates of whole data set. First, per capita income growth was not the only contributor in poverty alleviation in selected countries during the observed period. Second, improved education and health emerged as significant contributors in poverty alleviation.

As discussed earlier, enhancement of earning ability of people is due to better education and health. These both improvements interestingly may influence the poverty to decrease even if there is low growth in overall per capita income. Due to increased income of the poor even at low income growth poor can be uplifted in a sustainable way. It shows a difference between “making people enable” and “making people capable”.

The most suitable way to give a share from income growth to local poor is to provide them required education, skills and better health facilities. This will also be a permanent barrier to prevent people going back into poverty trap because less productive workers with lower skills are likely to be laid off first, whenever any business goes for contraction. Keeping in view the above mentioned conclusions the economic policy in developing countries, without neglecting income growth, should primarily focus on promoting education and health services to ultimately achieve the goal of poverty alleviation.

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Appendices

Appendix 1: List of Selected Sample Countries

No	Ids	Country Name	No	Ids	Country Name
1	ARM	Armenia	21	MDG	Madagascar
2	AZE	Azerbaijan	22	MYS	Malaysia
3	BLR	Belarus	23	MRT	Mauritania
4	BOL	Bolivia	24	MEX	Mexico
5	BRA	Brazil	25	MNG	Mongolia
6	BGR	Bulgaria	26	MOZ	Mozambique
7	KHM	Cambodia	27	NAM	Namibia
8	CPV	Cape Verde	28	NER	Niger
9	COL	Colombia	29	PAK	Pakistan
10	DOM	Dominican Republic	30	PAN	Panama
11	SLV	El Salvador	31	PER	Peru
12	ETH	Ethiopia	32	PHL	Philippines
13	GMB	Gambia	33	POL	Poland
14	GIN	Guinea	34	ROM	Romania
15	IDN	Indonesia	35	LCA	Saint Lucia
16	JAM	Jamaica	36	ZAF	South Africa
17	KAZ	Kazakhstan	37	SWZ	Swaziland
18	KEN	Kenya	38	TJK	Tajikistan
19	LSO	Lesotho	39	UKR	Ukraine
20	LTU	Lithuania	40	ZMB	Zambia

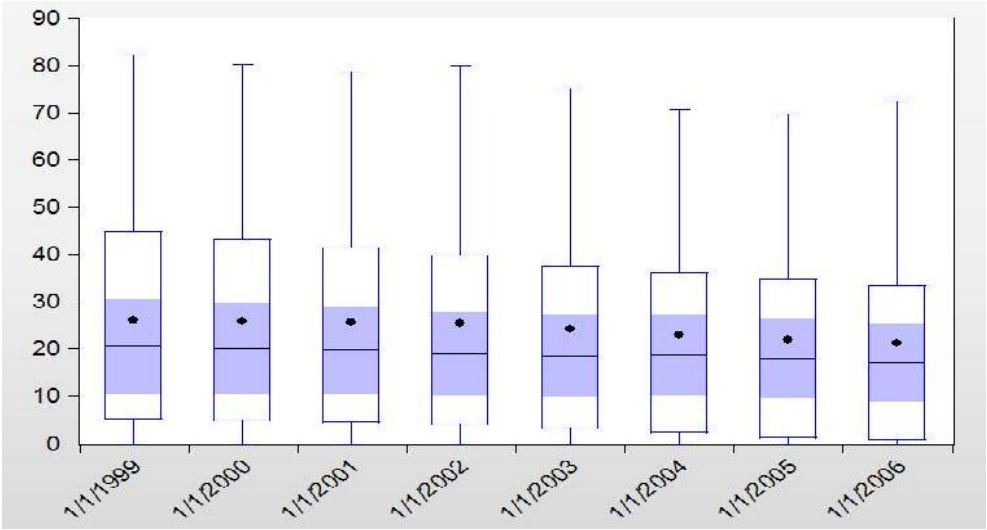
Appendix 2: Estimated Efficiencies of Selected Variables with 2 Inputs (%)

Output(s)	All 4	Poverty	Inequality	NES	LE
Country Name	**Efficiency**	**Efficiency**	**Efficiency**	**Efficiency**	**Efficiency**
Armenia	93	82	72	43	75
Azerbaijan	100	56	100	53	65
Belarus	37	20	37	29	34
Bolivia	35	25	32	25	35
Brazil	50	34	43	43	47
Bulgaria	54	33	46	37	51
Cambodia	100	90	89	100	100
Cape Verde	45	21	43	30	39
Colombia	47	32	36	45	46
Dominican	100	58	90	99	86
El Salvador	73	43	67	58	64
Ethiopia	58	51	43	50	50
Gambia	82	58	67	78	79
Guinea	87	8	67	85	85
Indonesia	100	100	80	100	100
Jamaica	41	25	36	21	41
Kazakhstan	70	43	55	44	70
Kenya	42	18	37	36	40
Lesotho	42	18	42	21	22
Lithuania	37	21	24	25	37
Madagascar	76	66	47	61	72
Malaysia	78	23	78	32	48
Mauritania	79	55	77	51	73
Mexico	48	30	41	45	41
Mongolia	47	28	34	46	38
Mozambique	46	21	40	31	46
Namibia	31	21	30	29	30
Niger	75	61	50	49	73
Pakistan	100	76	100	90	100
Panama	45	26	36	35	45
Peru	70	47	50	65	70
Philippines	71	37	70	63	69
Poland	40	22	32	30	40
Romania	61	39	44	36	61
Saint Lucia	43	20	36	41	36
South Africa	36	27	29	34	30
Swaziland	39	22	39	18	26
Tajikistan	99	97	52	80	74
Ukraine	39	25	35	18	39
Zambia	96	35	74	96	77

Appendix 3: Estimated Efficiencies of Selected Variables with 1 Input (%)

Output(s)	NES	LE		NES	LE
Country Name	**Efficiency**	**Efficiency**	**Country Name**	**Efficiency**	**Efficiency**
Armenia	36	33	Madagascar	41	62
Azerbaijan	38	44	Malaysia	17	48
Belarus	20	28	Mauritania	33	67
Bolivia	17	30	Mexico	31	31
Brazil	32	25	Mongolia	30	35
Bulgaria	29	27	Mozambique	21	37
Cambodia	100	32	Namibia	19	25
Cape Verde	17	39	Niger	35	50
Colombia	34	25	Pakistan	61	85
Dominican Republic	87	34	Panama	27	25
El Salvador	50	26	Peru	47	43
Ethiopia	34	40	Philippines	43	57
Gambia	61	40	Poland	20	32
Guinea	72	36	Romania	26	39
Indonesia	63	100	Saint Lucia	27	32
Jamaica	14	33	South Africa	25	18
Kazakhstan	31	50	Swaziland	12	23
Kenya	23	39	Tajikistan	59	43
Lesotho	9	22	Ukraine	13	28
Lithuania	17	29	Zambia	84	30

Appendix 4: Box-Plot of Poverty Headcounts



Appendix 5: Pro-/Anti-Poor Growth and Economic Efficiency for Poverty Reduction

No	Name of Country	Pro-Poor (Anti-Poor) Ranking	DEA Efficiency Ranking (%)
1	Armenia	11	93
2	Azerbaijan	18	100
3	Belarus	30	37
4	Bolivia	9	35
5	Brazil	14	50
6	Bulgaria	29	54
7	Cambodia	23	100
8	Cape Verde	19	45
9	Colombia	21	47
10	Dominican Republic	(34)	100
11	El Salvador	(33)	73
12	Ethiopia	5	58
13	Gambia	15	82
14	Guinea	(40)	87
15	Indonesia	3	100
16	Jamaica	24	41
17	Kazakhstan	28	70
18	Kenya	(37)	42
19	Lesotho	7	42
20	Lithuania	(32)	37
21	Madagascar	2	76
22	Malaysia	25	78
23	Mauritania	6	79
24	Mexico	16	48
25	Mongolia	10	47
26	Mozambique	(38)	46
27	Namibia	17	31
28	Niger	1	75
29	Pakistan	8	100
30	Panama	(36)	45
31	Peru	20	70
32	Philippines	(35)	71
33	Poland	(31)	40
34	Romania	26	61
35	Saint Lucia	22	43
36	South Africa	12	36
37	Swaziland	13	39
38	Tajikistan	4	99
39	Ukraine	27	39
40	Zambia	(39)	96