Economic Growth and Child Mortality

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Table of Content

1 Introduction

Economic growth in a country not only indicates materialistic gain of a society, but also carries a positive correlation with reduced child mortality, which is an integral part of overall increased human development. But, is this a direct correlation or does economic growth sway child mortality through micro and macro level variables? Before delving into answering the question, it is imperative to understand what child mortality implicates and why is it important to reduce child mortality to as low as possible?

Child mortality is considered to be a consequential instrument to indicate level of human development in a society. It is not only an indicative of number of children dying under age five, but it also sheds light on key human development and economic variables both at micro and macro level. Child mortality is more of a concern for developing countries than for developed, as approximately 11 million children under the age of five die every year mostly in the developing world with Sub-Saharan Africa leading the chart with highest level of mortality among children (UNICEF Statistics, 2006). Interestingly, this region also has the highest number of low development countries according to UNDP Human Development Report (2006). Human Development is measured in three dimensions – long and healthy life, knowledge, and decent standard of living.

Low income per capita, high fertility rate, high population growth, and low adult literacy rate could be the results of high child mortality. Literacy rate can highlight knowledge dimension of human development while income per capita and population growth can accent standard of living and healthy life dimensions, respectively. Income per capita is used by economists at both microeconomic and macroeconomic level to understand the choices of an individual or a country. Strulik (2003) suggests that high child mortality and low income per capita leads parents towards conceiving more children for financial reasons than leisure as they are unable to afford child quality expenditure, hence increasing child labor supply. Child mortality also is an indicative of health infrastructure of a country as high levels of mortality imply poor design of system with lower accessibility and utilization of health centers (Mosley and Chen, 1984).

Leading causes of child mortality are preventable and curable diseases – diarrhoeal and lower respiratory infections, malaria, and measles (WHO, 2003). Are these the factors that need to be

addressed to reduce child mortality or are there other factors more influencing than leading causes to reduce it? Several studies (Filmer and Pritchett (1997), Pritchett and Summer (1996), Deaton (2003), McGuire (2005), and Mosley and Chen (1984)) have addressed this question and have arrived to the same conclusion, but using different approaches, that other economic factors are more momentous than leading causes in order to reduce child mortality. This paper tries to garner those economic factors by understanding what various studies have ascertained. A quick survey of these studies suggests that national income is considered the best indicator of living standards since it comprises the value of products and services which are expected to influence mortality. Income per capita is focused on as a leading index in growth models which incorporate the relationship between economic development and mortality (Preston, 1975). But, is there a correlation between income per capita and mortality, more specifically child mortality? If so, is this relationship a deterministic one or can other socioeconomic factors can also influence child mortality of a nation?

Among other socioeconomic factors several other studies (Pritchett and Summers (1996), Filmer and Pritchett (1996), and Farah and Preston (1982)) also propose education to be a correlate of child mortality besides income. Education is used to measure individual productivity, which is determined by skills, health and time. Preferences and choices of a household are also dependent on education. Household income is determined by occupation which is strongly correlated with education level. Considering all these factors correlated with education, this paper attempts to establish the link between education and child mortality. This paper also tries to distinguish the effect of education of both parents on child mortality.

One would expect income inequality to be a significant variable when considering child mortality because poor families may spend about 80 percent of their income on food and leaving a small share for other variables (living conditions, hygiene, health services), so any variation in income and/or food prices will have drastic impact on the family's behavior towards spending. This change may translate to higher mortality (Mosley and Chen, 1984). However, high income families will have slight change of behavior in spending. This paper attempts to establish the relation between income inequality and child mortality by reviewing studies by Deaton (2003), and Filmer and Pritchett (1997).

Public health spending should also be considered when analyzing factors affecting child mortality. One would expect an increase in public spending on health will have negative effect on mortality since higher spending will improve health infrastructure. This paper we examine whether the above mentioned causation upholds (Lalou and LeGrand, 1997, and Filmer and Pritchett, 1997). Besides public health spending, McGuire (2005) and LeLou and LeGrand (1997) argue births attended by skilled health staff and access to health services can also be consequential when considering child mortality. This paper will also identify the exact association between above mentioned variables and child mortality.

Once the causation from economic growth to child mortality is established we examine whether reverse causation is true. While Kalemli-Ozcan (2002) takes the approach of identifying the relation between fertility, population growth and child mortality to establish the causation, Strulik (2003) approaches the causation from child mortality to economic growth by analyzing the impact of child mortality on child labor and economic development.

The remainder of the paper is organized as follows. Section II defines child mortality and how it impacts an economy of a country. Section III defines relation between economic growth and child mortality which attempts to identify the causation between the two. Section IV explores the reverse causation that is, whether reduction in child mortality promotes economic growth. The last section concludes the review.

2 Child Mortality

2.1 What is Child Mortality?

Child Mortality is defined as the number of deaths of children under 5 per 1000 people in a population per year. This is a broad definition of the term "Child Mortality." Infant and Under-5 mortality rate are the indicators used by international organizations and governments to measure child mortality. According to UNICEF (2006), Infant Mortality Rate (IMR) is defined as "the probability (expressed as a rate of per 1000 live births) of child born in a specialized year dying before reaching the age of 1 if subject to current age-specific mortality rates"[1] and Under-5 Mortality Rate is defined as "the probability (expressed as a rate of per 1000 live births) of child

[1] http://childinfo.org/areas/childmortality/

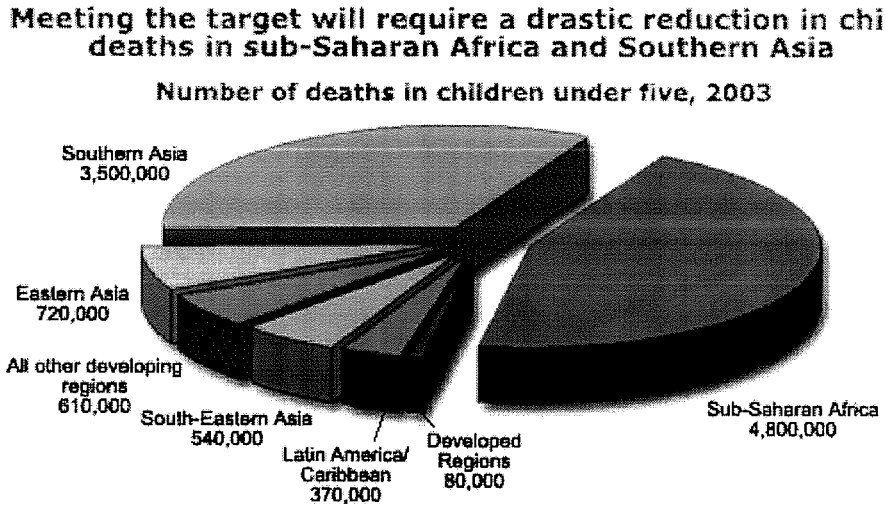
born in a specialized year dying before the age of five if subject to current age-specific mortality rates."[2]

Dictionary definition is very broad because it does not emphasize the significance of keeping the child mortality rate low on socio-economic development. Child mortality is not only a statistic, but it also reflects on health status and standard of living of a country. "A study of infant and child mortality is relevant to various aspects of social, economic, and health policy, planning and programming since high infant and child mortality rates are associated with poverty and depreciation."[3]

2.2 Current Situation

Even though child mortality has declined since 1960s as a whole, but it still remains as one of the major concerns in the world with approximately 11 million children under the age of 5 dying each year, that is, about 30,000 children every day. Developing countries, especially Sub-Saharan Africa and South Asia, are of major concern because most of the children dying live in developing countries (UNICEF Statistics, 2006).

Graph 1: Child Mortality by Region



Data source: UNICEF Statistic 2006

[2] http://childinfo.org/areas/childmortality/

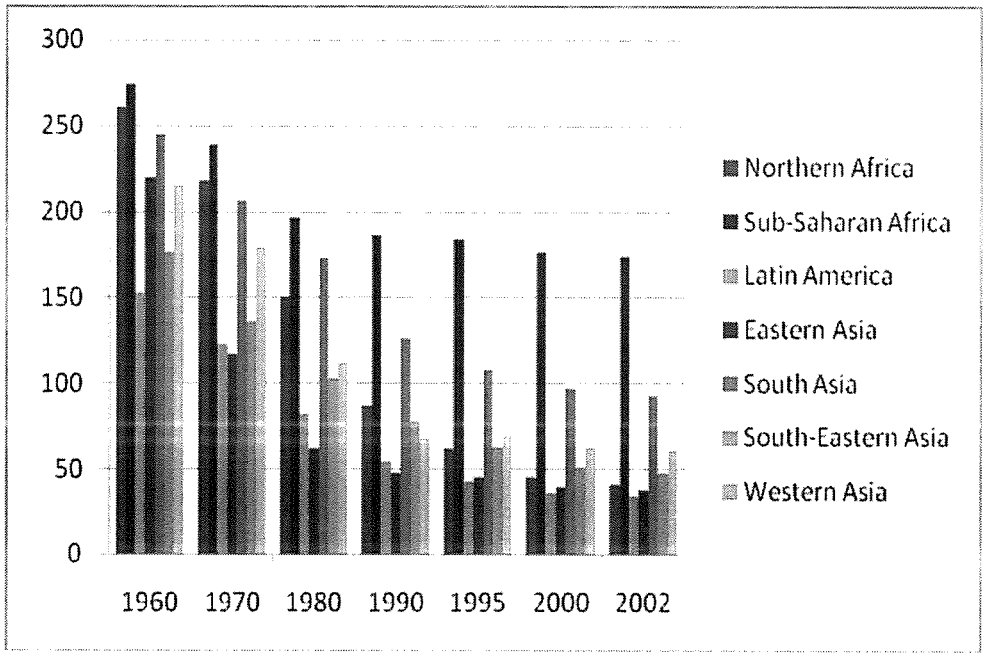
[3] Ikamari (2004, P. 1)

The graph above shows child mortality by region for year 2003. In Graph 1, more than 60% of the children dying before age five live in Sub-Saharan Africa and Southern Asia. Developed countries have the least number of deaths among children under age five.

Child mortality has declined over the couple of years, but has it been similar in all the regions? A study by Kenneth and Pebley (1989) concluded that "during the 1960-1980s, disparities in levels of child mortality between countries and regions of the developing world are very great and appear to have widened over the period."[4] Considering the period between 1980 and 2002, the disparities have widened even further between regions of developing countries, this is especially true for Sub-Saharan Africa when compared to other regions. The graph below (Graph 2) depicts the decline in the rate for regions of the developing world from 1960 to 2002. The decline in the rate of child mortality has been the slowest in Sub-Saharan Africa than any other region of the developing world. Child mortality in Sub-Saharan Africa was 274 per 1000 live births in 1960 and 174 per 1000 live births in 2002, followed by South Asia where child mortality was 245 and 93 per 1000 live births in 1960 and 2002, respectively. The difference between the best and the worst regions in terms of levels of child mortality has increased from 121 in 1960 to 140 in 2002.

[4] Hill and Pebley (1989, P. 680)

Graph 2: Level of Child Mortality in developing regions



Data source: UNICEF Statistic 2004

So far the regions with high child mortality have been shown but, what are the possible causes of children dying before they reach age 5 in those regions? According to WHO (2003), leading causes of children dying under age 5 are diseases.

Table 1: Leading causes of deaths in children in developing countries, 2002

Rank	**Cause**	**Numbers(000)**	**% of all deaths**
1	Perinatal conditions	2,375	23.1
2	Lower respiratory infections	1,856	18.1
3	Diarrhoeal diseases	1,566	15.2
4	Malaria	1,098	10.7
5	Measles	551	5.4
6	Congenital anomalies	386	3.8
7	HIV/AIDS	370	3.6
8	Pertussis	301	2.9
9	Tetanus	185	1.8
10	Protein-energy malnutrition	138	1.3
	Other causes	1,437	14
Total		**10,263**	**100**

Data source: WHO – World Health Report 2003

Table above shows the leading causes of child mortality in the developing countries. Most of the causes listed above are preventable if proper health care centers exist and vaccinations are provided. For example, Pertussis can easily be cured by immunization, proper vaccine and treatment is available for at-risk children for measles, proper treatment and healthy living environment can reduce the risk of children having low respiratory and diarrhoeal infections.

Unfortunately, children are not able to receive proper treatment or vaccination due to the lack of health care services, especially in low-density rural areas of developing countries. One reason that can be associated with the lack of health services in rural area is government allocation of resources (or funds). A government may believe that the development of urban areas is more important and beneficial for the country than the development of rural areas because the scope of investment is greater in urban areas. Other possible reasons for not receiving proper medical attention could be poorly designed education system where women literacy rate is low, not enough income to afford treatment, lack of accessibility and utilization of health services.

2.3 Impact of Child Mortality on an Economy

In our world, human development and economic growth are regarded as major indicators of a country's status. "Human development is viewed as the central objective of human activity and economic growth as potentially a very important instrument for advancing human development."[5] There exists a two-way causation between human development and economic growth. The causation from economic growth to human development determines how national income enhances human development, whereas the reverse causation explains how national income increases through social development. In this paper, spending on human development mainly refers to health and education as they are associated with reducing child mortality.

Child mortality not only has social implications but also economic implications. It is argued that if child mortality is high then human development will be considerably low. It is believed that child mortality not only reflects on core variables of an economy such as per capita income, income distribution, health, education, and also government priorities on public spending, but

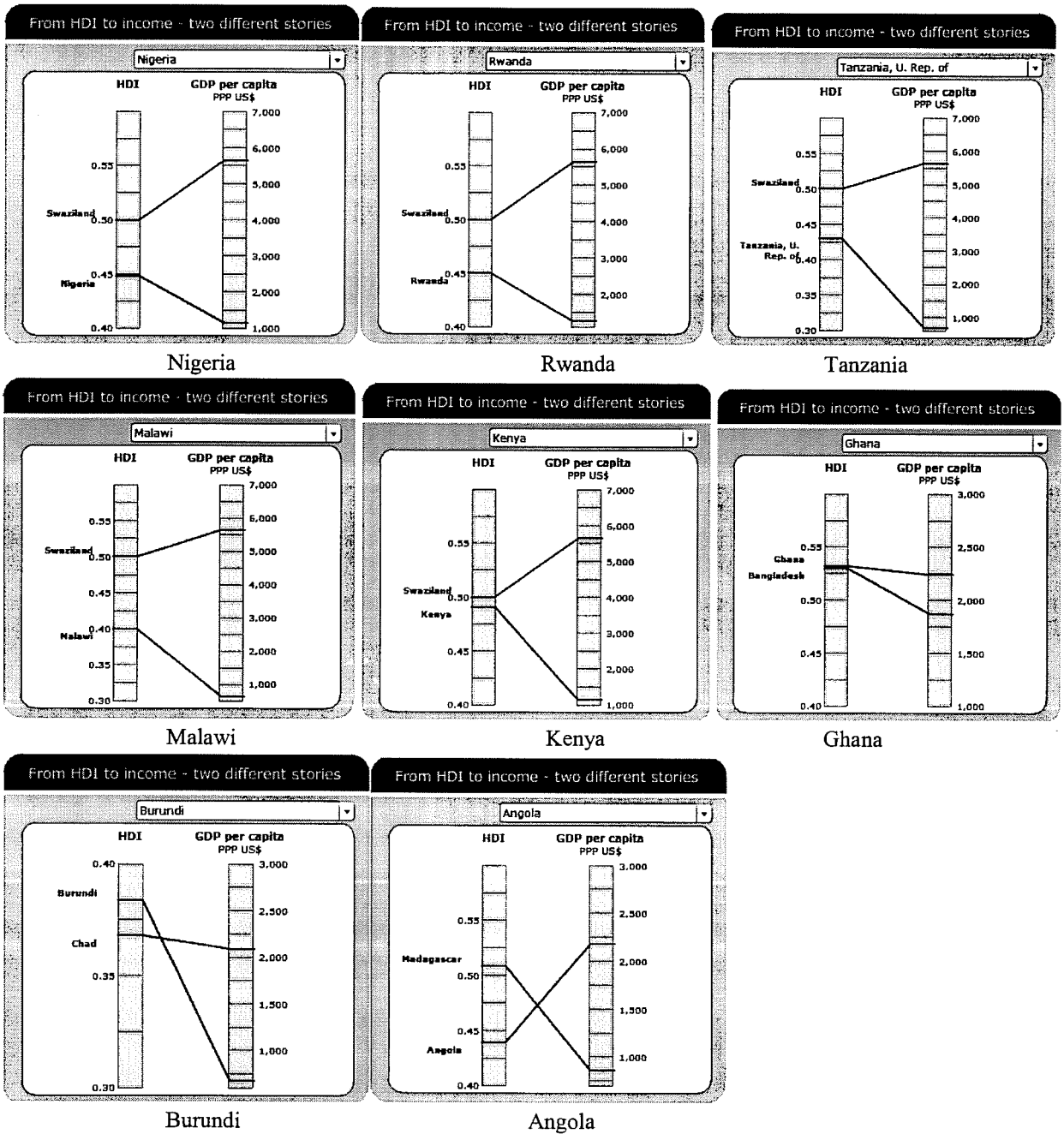
[5] Ranis, Stewart and Ramirez (2000, P. 198)

also on productivity and child labor as well. Combing all these variables gives insight as to the poverty level of a country.

2.3.1 Income and Income Distribution

So far, it has been argued that Sub-Saharan Africa has the highest child mortality as depicted in Graph 2. As mentioned above, child mortality is a good indicator of social development. By comparing HDI and GDP per capita, the graph below (Graph 3) gives an insight into the relationship between human development and income and it shows how some countries in Sub-Saharan Africa do better than others in turning income into education and health opportunities and therefore into higher levels of human development. The latter will lead to decline in child mortality. According to UNDP (2004), human development index can illustrate the distinction between income and human well being, especially of child welfare, by measuring average achievements in health, education, literacy, and income and thus giving a complete picture regarding the status of a country's development than income alone can. The index can also be used to determine and indicate whether a country is developed (high HDI between 0.800 and 1.00), developing (medium HDI between 0.500 and 0.799), or underdeveloped (low HDI between 0.300 and 0.499).

Graph 3: Human Development Index to Income



Nigeria Rwanda Tanzania

Malawi Kenya Ghana

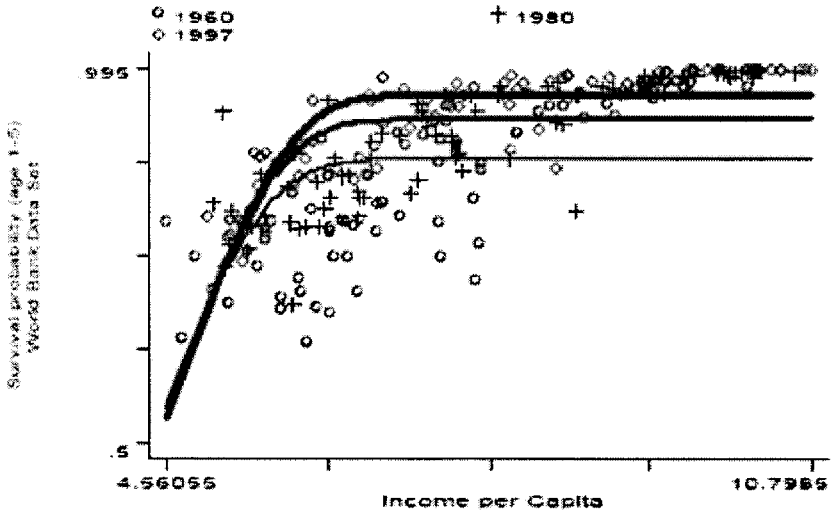
Burundi Angola

Source: Human Development Report 2006

Two different types of stories can be interpreted from Graph 3. One way of analyzing the graph above is to look at countries with the same level of GDP per capita, but different level of human development index. For example, Angola has the same GDP per capita as Ghana, but the human development index is only 0.45 (underdeveloped country) compared to Ghana's 0.55 (developing country). This can imply that one or all of the dimensions of human development

(education health, literacy, and standard of living) are higher in Ghana than Angola. Another way of analyzing the graph above is to look at countries with the same level of human development index, but different level of GDP per capita. For example, countries like Nigeria, Rwanda, Tanzania, and Kenya have same human development index as Angola even though there GDP per capita is much lower. This indicates that these countries are better able to translate wealth into human development than Angola by improving any or all the dimensions of human development (UNDP, 2004). Comparing child mortality between these countries, Ghana has the lowest child mortality and Angola has the highest (Table 8), even though both countries have the same GDP per capita. Thus it can be interpreted that human development index is as important measure of a country's development as GDP per capita and child mortality is one of the major indicators of human development. Hence in general, high child mortality can imply low social development which can potentially lead to low economic growth. Graph below taken from Kalemli-Ozcan (2002) shows this point that as income per capita increases, survival probabilities for children between age of 1 and 5 also increases. Thus, high child mortality could be an indicator of low per capita income.

Graph 4: Survival Probability (age 1-5) vs. Income



Source: Kalemli-Ozcan (2002)

A level of poverty is usually measured through per capita income and/or income distribution. As it will be shown in later sections, bottom tail of the income distribution has higher child mortality

than top tail. Hence, if child mortality is high then one of the implications can be that a big proportion of the population of a country lies below the poverty line (that is less than dollar a day) and hence indicating that there exists huge disparity in income distribution. This in turn leads to less private spending on health and education of children of poorest 20 percent of the population.

2.3.2 Fertility Rate

Child birth is costly for both the government and parents. Government spends a significant amount of public spending on public health and education infrastructure by providing health services, training to doctors and nurses, medication for immunized and non-immunized diseases to ensure child bearing and child quality expenditure is low. Parents also have to spend significant amount on child bearing and child quality expenditures. If parents belong to bottom-tail of income distribution then a significant portion of their income is spent on birth of their child. If mortality level is high for children under age five then parents are more likely to substitute child quality by fertility, hence spending lesser amount on surviving children and more on conceiving additional children (Strulik 2003). High child mortality thus increases fertility rate which will lead to a fall in the share of parents' income spent on improving their children lives. Less focus on child quality feeds into increasing the probability of children dying before the age of five. Rise in fertility rate will also increase population growth.

2.3.3 Education and Productivity

Another core economic variable that child mortality reflects on is education, more specifically parental education. Education is an important factor that affects child mortality. As it will be shown in later sections, having one additional year of education by either mother or father, or both, reduces significantly child mortality. High mortality level may give indication as to the level of literacy in a country but also of to the level of income. Mother's education is more closely associated with child care, including both utilizing health services when required and taking precautions to avoid any diseases or infections related to children. Since women education has direct negative effect in reducing child mortality, it can be said that higher child mortality may imply lower literacy rate for females, which again reflects poorly on standard of living of a country. At the same time, male education has indirect negative effect on child mortality. Male

education effect comes in the form of household income because in most developing countries head of the family (most often male) is the sole breadwinner of the household. Higher the education is, higher the household income and lower child mortality. Hence, high levels of child mortality imply low per capita income, high poverty level and low economic growth which can categorize a country as low to medium income developing country.

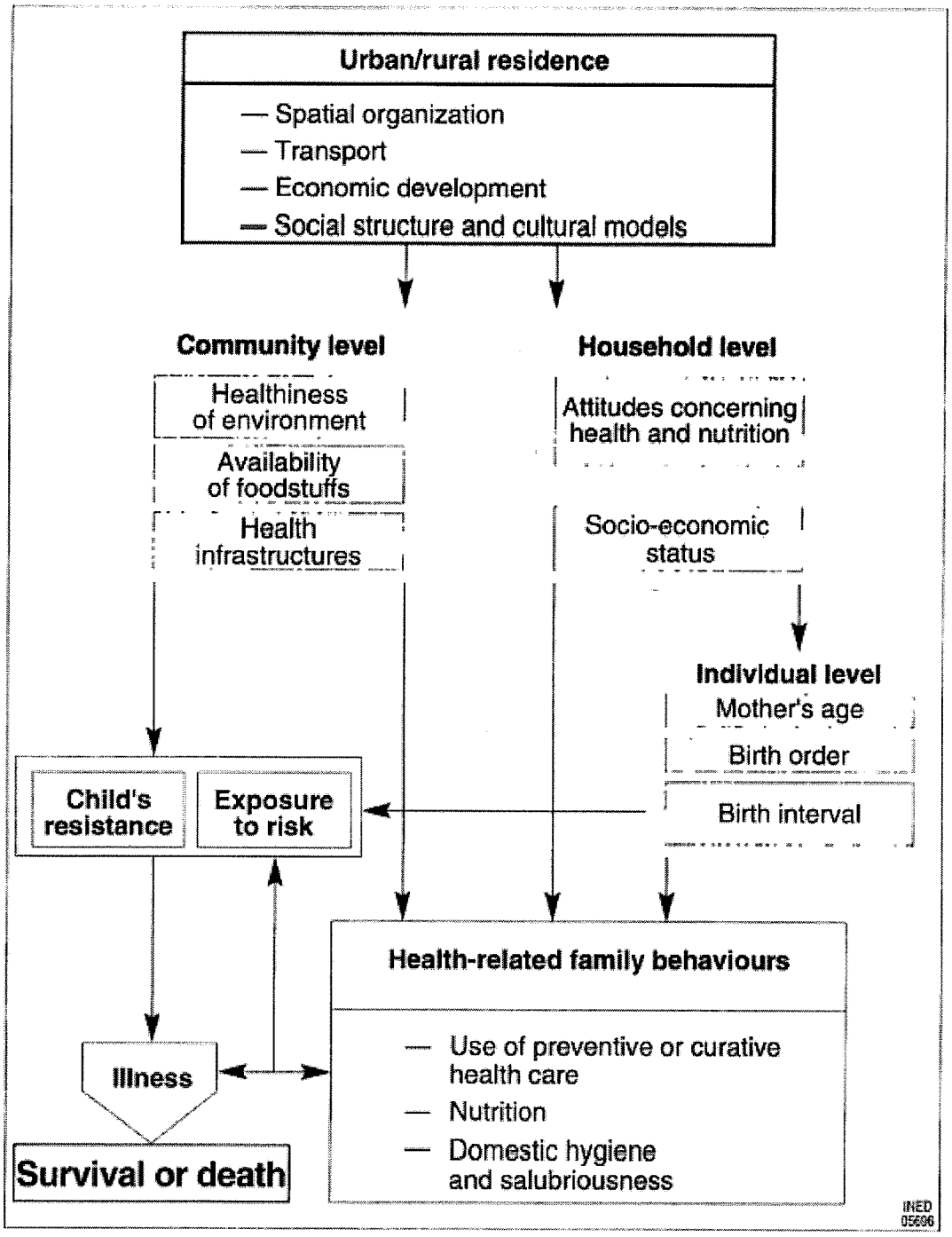
Another implication of high child mortality is the decrease in productivity. Knowing that there are high chances of children not surviving up to age 5, parents are constantly under pressure and stress which impacts their productivity level at work which could eventually lead to rise in unemployment. As mentioned above, parents are less likely to spend on surviving children if child mortality is high hence, leaving surviving children with poor health and high illiteracy rate. This in turn will lead to overall decline in productivity of a country.

2.3.4 Rural-Urban Ratio

It is assumed that urban population has lower level of child mortality than rural because government focuses more on urban health infrastructure which could mean large number of health centers, technologically advanced medical instruments, and high number of doctors and nurses. Anan (1998) stated that "urban hospitals are given preferences over primary health care, only about 30 percent of aid for health care goes to basic health services and facilities" and "urban water supply is given preference, less than 20 percent of aid for water and sanitation services goes to rural area or to low-cost mass coverage programmes."[6] Urban population is, on average, more educated and resourceful than rural which results in higher utilization of health services than rural. However, LeLou and LeGrand (1997) state that socioeconomic characteristics of a household can offset the handicap of fewer medical services and unhealthy living environment in rural areas. Below is a conceptual framework of urban and rural health infrastructure and it analyses the relation between place of residence and health status of children.

[6] Kofi Anan (1998)

Graph 5: Conceptual Framework for analyzing the relation between place of residence and health status of children



Source: Lalou and LeGrand (1997)

Not only health infrastructure, transportation and education system are also well designed in urban areas than in rural. Accessibility increases with better transportation system because it allows even for poor population to access health centers when expecting or children need medical attention. Literacy rate is also better for urban population because of better education system, including higher number of schools.

The graph above integrates all these variables into three levels: community, household, and individual. The opposition between urban/rural residences comes within these levels such as health and medical facilities, transportation, and education system, which are characteristics specific to community, are better for urban residences than rural, at least in terms of providing service. According to graph 5, another place where urban/rural differentiates is at household level through socio-economic status, more economic access to health care, and attitudes concerning health and nutrition. The urban effect comes through widespread schooling hence, better knowledge regarding nutrition and health. All the variables in these three levels act either directly or indirectly on exposure to health risks and eventually determine the probability of child survival as shown in the graph. High level of mortality among children can imply that rural population is higher than urban (LeLou and LeGrand, 1997). Again, if rural population is more than urban then per capita income would be low and standard of living and economic growth will also be low as urban population contributes significantly to the labor market and hence to Gross Domestic Product .

2.3.5 Child Labor

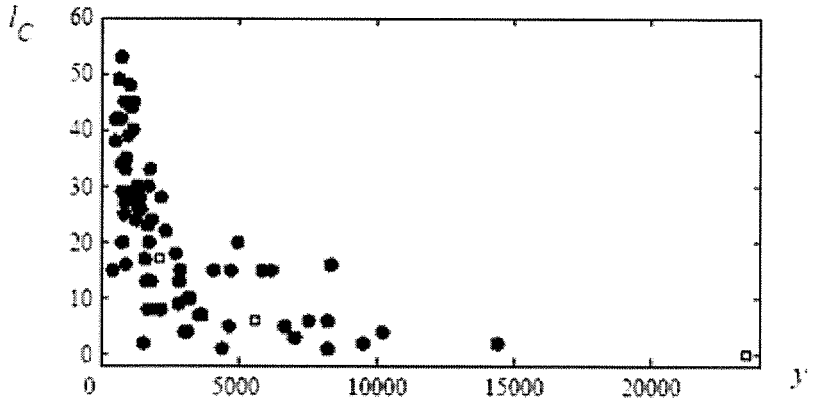
Child mortality and income per capita are main determinants of parents' decision on fertility, child quality or child quantity. Child quality expenditure means private spending on health and education of a child. Based on their decision, child labor, population growth, and income per capita is also affected. A decision will lean towards child quantity rather than child quality if parents live in a low-income country with high child mortality. A study by Strulik (2003) gives an explanation regarding parent fertility decision and child mortality. In this study, the author considers two cases: interior and corner solution. "At the corner, the increase in utility of spending the first unit of income on child quality is exceeded by (opportunity) costs, and the

parent prefers to spend the unit of income on consumption and having another child."[7]The main intuition behind child mortality, child labor and economic development is that in low-income countries, parents have to decide whether to choose child quality (that is, child's health, and education) and child quantity. If mortality is high and child quality expenditure is not affordable, then parent decides to have more children, and put them to work to co-finance the cost of having them, hence, increasing child labor of the country. With increasing child supply, population growth also starts to rise, which in turn will reduce income per capita and economic growth will stagnate. This topic will be discussed further on the survival rate and population growth.

Strulik (2003) suggests that a household with less than $300 per year will have high child mortality, since parents will not be able to afford child quality and hence will conceive more children and increase child labor supply. As income increases and reaches $450 a year, this rise will be high enough to reduce child mortality moderately and parents are able to pay attention to child quality. As income rises, children survival rate keeps increasing and fertility rate decreases. Parents also start to focus on child quality and hence child labor supply declines, shown in the graph below taken from Strulik (2003). Thus, child mortality has an important impact on child labor supply. High level of mortality among children results in higher rate of child labor supply.

[7] Strulik. (2003, P. 6)

Graph 6: Labor Market Participation Rate of 10-14 Years Old Children Against Income Per Capita



Data from Worldbank (2000) for 69 countries with positive participation rates. Squares show averages for economies with low, middle, and high income.

Source: Strulik (2003)

In conclusion, child mortality has a significant effect on economic variables but also demographic variables. By observing child mortality, several insights can be derived on standard of living of a country which includes income per capita, income distribution, health and education system, and rural-urban population ratio, but at the same time several lessons can be ascertained about the demographics of a country as well such as fertility rate, population growth and child labor.

3 Economic Factors

There is a strong relation between economic growth and human development. It is said that as a country grows economically, there is bound to be some effect on social status of the country. This change in social status or human development can be measured using human development index developed by UNDP in 1990. One of the measure indicators of human development is child mortality.

Child mortality alone can give some indication regarding household income, distribution of income, adult literacy, and government priority in public spending. Filmer and Pritchett (1996)[8]

[8] The findings refer to Table 1 in Filmer and Pritchett (1997, P. 8)

regressed under-5 mortality rate as a function of income, female education and income distribution among other variables and found that income (as natural log of GDP per capita), and female education to be highly significant at one percent significance level, and income distribution to be significant at five percent significance level. Other variable that was found to be highly significant at one percent significance level when regressed on the dependent variable under-5 mortality is ethnolinguistic fractionalization. The significance of above variables was true for both Ordinary Least Square (OLS) and Two-Stage least square. Infant mortality and child mortality are highly correlated variables, however, according to Filmer and Pritchett (1997), some variables are highly significant to infant mortality (0-1 year) but not to child mortality (1-4 years) such as urban population (in percent) and whether the county is tropical.

In the next sub sections we will examine whether these variables are significant and see whether a country focuses on these issues to reduce child mortality. In order to get a clear picture, we will analyze data from eight countries in Sub-Saharan Africa: 2 countries from each region of the continent. The countries chosen for observation are Angola, Malawi, Burundi, Ghana, Nigeria, Rwanda, Kenya, and Tanzania. All these countries are low human development countries with the exception of Ghana which is a medium human development country according to UNDP Human Development Report 2006. Human Development Index (HDI) has been used by UNDP to decide which group a country belongs to. The Graph below list eight countries mentioned above with their Human Development Index for years 2002 to 2004.

Table 2: Human Development Index

	2002	**2003**	**2004**
Angola	0.381	0.445	0.439
Malawi	0.388	0.404	0.4
Burundi	0.339	0.378	0.384
Rwanda	0.431	0.45	0.45
Kenya	0.488	0.474	0.491
Tanzania	0.407	0.418	0.43
Ghana	0.568	0.52	0.532
Nigeria	0.466	0.453	0.448

Data source: UNDP Human Development Report 2004-06

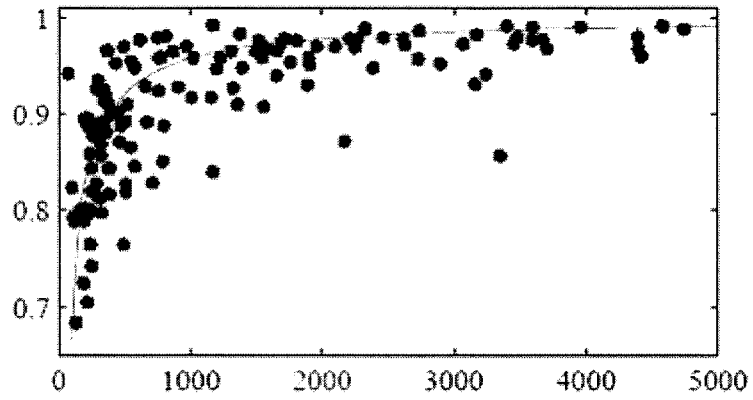
A country is considered to be a medium human development if the Human Development Index is equal or greater than 0.5. It can be seen in the graph, only Ghana has HDI greater than 0.5 for all three years, but it has declined since 2002 from 0.568 to 0.532 as is the case for Nigeria, low human development country, where HDI dropped from 0.466 to 0.448.

3.1 Growth

There is a strong causation between income per capita and child mortality but it is through spending on human development which consists mostly of health and education. Low income per capita indicates high level of poverty. It is said that "when level of poverty in a country is high either because per capita income is low or badly distributed the expenditure of many households on human development is bound to be low."[9] This implies that as income of household increases (especially, of bottom tail of income distribution), the expenditure on goods and services (nutritious food, health, education, transportation, hygiene, and housing) increases. Increases in these variables, which directly affect children well being, are bound to have an effect on child mortality as shown in the graph below where child survival rate is low for countries whose GNP is less than $1000. But, as GNP grows from $1000 to $5000, the child survival rate also increases.

[9] Ranis, Stewart and Ramirez (2000)

Graph 7: Child Survival Rate Against Income Per Capita



Child survival rate (π) is 1− the "Under- 5 Mortality Rate". Data for 126 countries with GNP per capita below $ 5000 in 1999 from UNICEF (2001). The solid line represents the correlation implied by the basic numerical specification of the model (See Section 5).

Source: Strulik (2003)

There is no direct effect between increase in average income and mortality rather the fall in child mortality is due to poverty reduction and/or increase in public spending on health. As shown in a study conducted by Pritchett and Summers (1996) that "economic growth flows into health gains" which in turn reduces the infant mortality in the developing countries. For example, quintupling of GDP of Korea reduced child mortality by 80 percent compare to 12 percent increase in GDP of Argentina reduced child mortality by half.

It is believed that if growth of a country is above average, then it has negative effect on child mortality. This is found in studies by Filmer and Pritchett (1997) and Summers and Pritchett (1996). The economic model where child mortality is regressed on natural log of GDP per capita among other variables (Filmer and Pritchett, 1997) shows that GDP per capita (natural log) is significant at one percent significance level in both OLS and Two-stage least squares regression. However, when other socioeconomic factors are included in the regression (e.g. income inequality, parental education), the net effect of GDP per capita falls but is still highly significant. It is stated by Filmer and Pritchett[10] that:

[10] Filmer and Pritchett (1997, P. 7)

> "A large part of the variation in (the natural log of) under-5 mortality can be 'explained' by (the natural log of) GDP per capita and a set of region dummy variables only. Even excluding the regional dummy variables, 84 percent of mortality differences can be 'explained' by income alone. The more striking result is that when a few other variables are included over 94 percent of the variation in the under-5 mortality rate is explained."

Still, income growth does not always result in fall in child mortality by the same proportion. It is possible to have below average growth rate, but positive decline in child mortality if resources are allocated efficiently for socioeconomic factors (health, education, income distribution). At the same time, it is also possible to have above average growth followed by slight decline in child mortality due to the absence of impact of the increase in income on health if the increase is accrued entirely to the top one percent of income distribution. Hence, "a reduction in growth rates will substantially slow the improvement of the child health."[11]

Table 3: Income Growth and Infant Mortality, Percentage Changes in Selected Countries, 1960 to 1990

	Income Growth					
	Above Average			Below Average		
Fall in Infant Mortality	**Country**	**Income Growth (%)**	**Infant Mortality Fall (%)**	**Country**	**Income Growth (%)**	**Infant Mortality Fall (%)**
Above Average	Korea	500	80	Jamaica	39	74
	China	240	78	Sri Lanka	51	72
	Turkey	127	70			
Below Average	Pakistan	97	36	Ghana	-14	35
	Brazil	190	50	Somalia	-18	28

Source: Summers and Pritchett (1997)

In the table above, it can be seen that for Korea, China, and Turkey both income growth and fall in infant mortality were above average. However, Pakistan and Brazil saw less-than-average improvement in infant mortality rate even with rapid economic growth, and Sri Lanka and Jamaica saw above-average improvement in infant mortality rate despite relatively moderate growth. On contrary, there was less-than-average improvement in infant mortality rate in spite of negative growth. The table above testifies the point made above that income growth is essential

[11] Pritchett and Summers (1996, P. 863)

but is not the only determinant to reduce child mortality. Other factors like health, income distribution and education are also crucial.

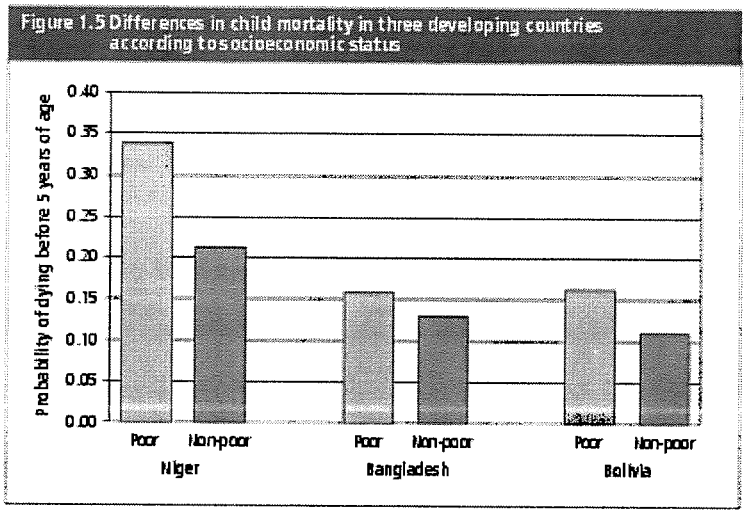
3.2 Income Inequality

Besides the preventable diseases, income distribution and income inequality plays a significant role in reducing child mortality. Deaton (2003) discusses the relationship among health, income inequality, and economic development. The major point in this study was that for a poor country, the focus is on average income and how it is distributed, whereas for a rich country, average income is of less importance than income inequality. The relationship between income distribution and child mortality is stated very neatly in this study as when "conditional on mean income, the share of income going to the poorest of 20 percent of the population decreased infant mortality and the share of income going to the 5 percent increased infant mortality."[12] Infant mortality and child mortality are highly correlated variables, so it can be said that the factors that have an impact on infant mortality will also have the same affect on child mortality. According to the previous statement, it is not only important for the average income to be high, but individual household income (especially for low income households) is also a factor in reducing child mortality rate. This conclusion is also found by Pritchett and Summers (1996), where they state that "mortality for children at various ages falls with changes in factors related to household income."[13]

[12] Deaton (2003)

[13] Pritchett and Summers (1996, P. 861)

Graph 8: Differences in child mortality in three developing countries according to socioeconomic status



Data source: WHO – World Health Report 2003

The graph above provides insight on the concentration of child mortality. For all three developing countries in the graph, the probability of children dying before age five is higher among poor than non poor, but the disparity between the probabilities is much higher in Niger than in other two countries.

Table 4: Inequalities in Maternal and Child Health

	Births Attended by Skilled Workers (%)		Under-5 Mortality Rate (per 1000 live births)		Infant Mortality Rate (per 1000 live births)		
	Poorest 20 %	Richest 20 %	Poorest 20 %	Richest 20 %	Poorest 20 %	Richest 20 %	Survey Year
Malawi	43	83	230.8	149	131.5	86.4	2000
Rwanda	17.3	59.6	246.4	154.1	138.7	87.9	2000
Tanzania	28.9	82.8	160	135.2	114.8	91.9	1999
Kenya	23.2	79.6	136.2	60.7	95.8	40.2	1998
Ghana	17.9	86.1	138.8	52.2	72.7	26	1998
Nigeria	12.2	70	239.6	119.8	102.2	68.6	1990

Data source: Human Development Report 2005, UNDP

Following the same logic, the table above shows the inequality in maternal and child health among poor and rich. It can be seen that the percentage of birth attended by skilled worker is considerably lower for bottom 20 percent of income distribution than for top 20 percent. Same

analyses can be made for under-five and infant mortality rate where poorest 20 percent have notably higher rates than richest 20 percent. One take on this result could be that higher class individuals are better able to access health services because they can arrange for proper transportation, and also they are able to provide at least modest living conditions to prevent leading causes of child mortality especially lower respiratory and diarrhoeal infections.

As mentioned previously, it is very crucial to have right income distribution as the disparity between poor and rich is huge and having lasting effect on child mortality. One of the possible solutions could be that income needs to be distributed more evenly to pull up bottom tail (poorest 20 percent) at least up to the point where income has very little effect on health. Increase in income of poorest 20 percent will have higher effect on reducing child mortality rather than richest 20 percent because they already can meet basic survival needs.

3.3 Government Spending

An increase in income per capita is not the only way to reduce child mortality. Government priority in public spending also plays an important role. In public spending, the most concerned areas regarding child mortality are health and education spending. The table below depicts government spending on public health as a percent of GDP for the countries under observation.

Table 5: Public Health Expenditure (% of GDP)

	2000	**2001**	**2002**	**2003**
Angola	2	2.8	2.1	2.4
Malawi	3.6	2.7	4	3.3
Burundi	1.7	2.1	0.6	0.7
Rwanda	2.6	3.1	3.1	1.6
Kenya	2.4	1.7	2.2	1.7
Tanzania	2.2	2.1	2.7	2.4
Ghana	2.2	2.8	2.3	1.4
Nigeria	0.5	0.8	1.2	1.3

Data source: Human Development Report 2003-6, UNDP

It can be observed that government spending on health is not very high and in some cases spending has decreased significantly in countries such as Burundi and Rwanda. Spending on health fell from 2.1 percent of GDP in 2001 to mere 0.7 percent in 2003 for Burundi and from

3.1 percent in 2001 to 1.6 percent in 2003 for Rwanda, whereas, Malawi had a significant increase in health spending from 2.7 percent in 2001 to 3.3 percent in 2003.

In 1990, most of the developing countries were under Structural Adjustment Program (SAP) sponsored by International Monetary Fund (IMF) and World Bank. Under these programs, a major portion of the GDP was used for debt services, hence leaving a small portion of spending on social programs such as health and education. Social programs were dramatically cut during SAP periods (Ikamari, 2004, and Bradshw et.al 1993).

Table 6: Government Spending on Health, Education and Debt Service in 1990 and 2000-4

	Health Expenditure (% GDP)		**Education Expenditure (% GDP)**		**Debt Service (% GDP)**	
	1990	2003-04	1990	2000-3	1990	2003
Angola	2.1	2.4	3.9	2.8	3.2	10.1
Malawi	4	3.3	3.2	6	7.1	2.1
Burundi	0.6	0.7	3.4	5.2	3.7	4.9
Rwanda	3.1	1.6	--	2.8	0.8	1.3
Kenya	2.2	1.7	6.7	7	9.2	4
Tanzania	2.7	2.4	2.8	--	4.2	0.9
Ghana	2.3	1.4	3.2	--	6.2	6.2
Nigeria	1.2	1.3	0.9	--	11.7	2.8

Data source: Human Development Report 2005, UNDP

Health Expenditure in the above table is total health expenditure which includes private health expenditure, current and capital government budgets, external borrowing and grants, and social health insurance funds. Education expenditures include capital and current expenditures. It can be seen that all these countries had debt services in 1990 and 2003 with Nigeria leading the chart in 1990 with 11.7 percent and Angola in 2003 with 10.1 percent. It can clearly be seen from the table above that despite significant reduction in debt services of some countries, health expenditure has not increased significantly; instead it has decreased. For example, Nigeria's debt services has fallen down from 11.7 percent in 1990 to 2.8 percent in 2003, but health expenditure only increased by 0.1 percent from 1.2 percent in 1990 to 1.3 percent in 2003. Similarly for Kenya, despite the reduction in debt service from 9.2 percent of GDP to 4.0 percent, health expenditure fell from 2.2 percent of GDP to 1.7 for 1990 and 2003, respectively. What meaning could we get from these figures? They may indicate that governments in these countries did not

pay enough attention to health expenditures as latter did not appear as priority in public spending.

Considering Table 5 and Table 6 together, it can be seen that in 2000 health expenditure fell for almost all the countries with the exception of Burundi and Kenya, when compared to figures in 1990. Interestingly, according to the data the figures for public health expenditure in 1990 are similar to those of year 2002. This implies that it took almost twelve years to reach the 1990 level of spending on public health. It is a good indication that some countries are trying to focus on public health whereas public health expenditure of Burundi had improved dramatically from 0.6 percent of GDP in 1990 to 2.1 percent in 2001, but it deteriorated drastically to 0.6 percent in 2002.

Table 7: Under-5 Mortality Rate (per 1000 live births)

	2000	**2001**	**2002**	**2003**
Angola	295	260	260	260
Malawi	188	183	183	178
Burundi	190	190	190	190
Rwanda	187	183	183	203
Kenya	120	122	122	123
Tanzania	165	165	165	165
Ghana	102	100	100	95
Nigeria	184	183	183	198

Data source: Human Development Report 2003-2006, UNDP

When comparing public health expenditure to under-5 mortality rate, there is no clear indication as to what effect public health spending had on child mortality. For instance, spending on public health decreased for both Rwanda and Kenya, more drastically for Rwanda (3.1 percent to 1.6 percent) than for Kenya, child mortality rose for these two countries more so for Rwanda (from 183 in 2002 to 203 in 2003) than for Kenya (122 per 1000 live births in 2002 to 123 per 1000 live births in 2003). On contrary, public expenditure on health for Malawi also decreased from 4 percent to 3.3 percent, but child mortality also fell from 183 per 1000 live births to 178 per 1000 live births (Table 7). Whereas, comparing public health expenditure of Ghana and Nigeria give a contradictory outcome. Even though, health expenditure for Ghana fell from 2.3 percent to 1.4 percent in 2002 and 2003 (Table 5), respectively, under-5 mortality rate fell from 100 per 1000 live births to 95 per 1000 live births (Table 7). Observation for Nigeria is opposite to that of

Ghana where under-five mortality rate increases even though public expenditure also increased. From these observations, it is not clear how public health expenditure affects child mortality. A study by Filmer and Pritchett (1997) tries to answer this question where they state that "there is an enormous gap between the apparent potential of public spending to improve health status and the actual performance."[14] As it is clear, public spending alone is an ineffective way to reduce child mortality. In fact it has very minimal to none actual impact on child mortality. As noted by Filmer and Pritchett (1997) "The extremely small impact of public spending that we estimate from the cross-national data implies that the typical health spending on health per child death averted is $50,000 to $100,000, a striking discrepancy between apparent potential and actual performance."[15]However, Conley and Springer (2001) argued that increased investment in public health will lower infant mortality for rich countries. In this study, Conley and Springer (2001) found that "each additional 1 percent in per capita health care spending – in the base model – is associated with a reduction in the infant mortality by 0.184 percent. (...) A cumulative effects-of-state-spending model over a three to five year period found an increase of 1 percent in per capita of health spending associated with 0.348 percent reduction in infant mortality."[16]

3.4 Basic Health Care

3.4.1 Births attended by skilled staff

Public spending on health is an important starting variable to look at when trying to reduce child mortality, but it is also imperative to look at how these spending translate into providing effective health services. That is, it is crucial to understand the crux of health spending. An article by McGuire (2005) tries to understand conflicting views regarding how important the share of GDP spent on health is. In this article, the author points that some studies suggest that "the larger the share of GDP spent on public health care, the lower the national infant mortality rate"[17], especially the share of public primary health care spending. But at the same time, McGuire (2005) mentions other studies which show little support to misallocation of public

[14] Filmer and Pritchett (1997, P. 3)

[15] Filmer and Pritchett (1997, P. 4)

[16] Conley and Springer (2001, P.799)

[17] McGuire (2005, P. 2)

health fund to explain weak connection between public health spending and child mortality. The article suggests that rather than spending, it is the quality, accessibility, and utilization of health services that matters because "public health care spending shows no association with under-5 mortality in most cross-national studies of developing countries may be that the maternal and child health care interventions that are most effective in reducing under-5 mortality are so inexpensive that they do not even show up in data on the share of public health spending devoted to 'basic,' 'local,' or 'primary' health care services."[18] According to the study by McGuire (2005), some of the variables which are found to have major impact on under-5 mortality rate are percent of births attended by trained staff, access to district clinics especially in rural areas, and use of these clinics by expectant mothers.

After regressing basic health care indicators on under-5 mortality, McGuire (2005) found percent of births attended by trained health staff to be significant at the five percent level, the share of population with access to maternal and child health services to be highly significant at the one percent level, care of delivery (such as cutting the umbilical cord with clean blade, etc.) to also be significant at one percent level. Having a skilled attendant at the time of delivery is also found to be significant at the five percent level. This variable is different than percent of births attended by trained health staff because it also includes midwives who are more accessible than health centers in rural regions. The indicators such as hospital beds, physicians, nurses, and monitoring and evaluation do not seem to be significant enough to be considered as medical interventions to reduce child mortality. This regression also has public and private health spending as an independent variable and these variables are found not to be as significant as the once mentioned above. Below is a table listing shares of births attended by skilled workers for countries under evaluation. The data is for the most recent year available for the period specified, so it might not portray the current situation of the country but it does provide some indication towards the trend of this variable.

[18] McGuire (2005, P. 17)

Table 8: Percent of Births attended by Skilled Workers (including Doctors, Nurses, and Midwives)				
	1995-2001	**1995-2002**	**1995-2003**	**1996-2004**
Angola	23	45	45	45
Malawi	56	56	61	61
Burundi	25	25	25	25
Rwanda	31	31	31	31
Kenya	44	44	41	42
Tanzania	36	36	36	46
Ghana	44	44	44	47
Nigeria	42	42	35	35

Data source: Human Development Report 2003-6, UNDP

Another economic analysis in which McGuire (2005)[19] merges the independent variables used by Filmer and Pritchett (1997) to observe the relation among GDP per capita, health spending and share of births attended by skilled staff. Independent variables used in regression by Filmer and Pritchett (1997) were natural log of GDP per capita, female educations, income inequality, predominantly Muslim, and ethnolinguistic fractionalization. The natural log of GDP per capita when regressed on under-5 mortality was found to be highly significant with expected negative sign at one percent significance level. When the share of births attended by skilled staff was added to the model of Filmer and Pritchett (1997), the coefficient of the added variable was also found to be highly significant at one percent significance level with the expected negative sign. But the coefficient's t-statistic was lower than that of the log of GDP per capita because "the share of births attended by skilled staff was highly correlated with the log of GDP per capita (+0.73)."[20]

In the 94-country data set used by McGuire (2005) for the regression, "the predicted decline in under-5 mortality was 30 per 1000 when GDP per capita rose by one standard deviation, compared to 14 per 1000 when birth attendance rose by a similar amount."[21] GDP per capita

[19] The findings refer to Table 3 in McGuire (2005, P.16)

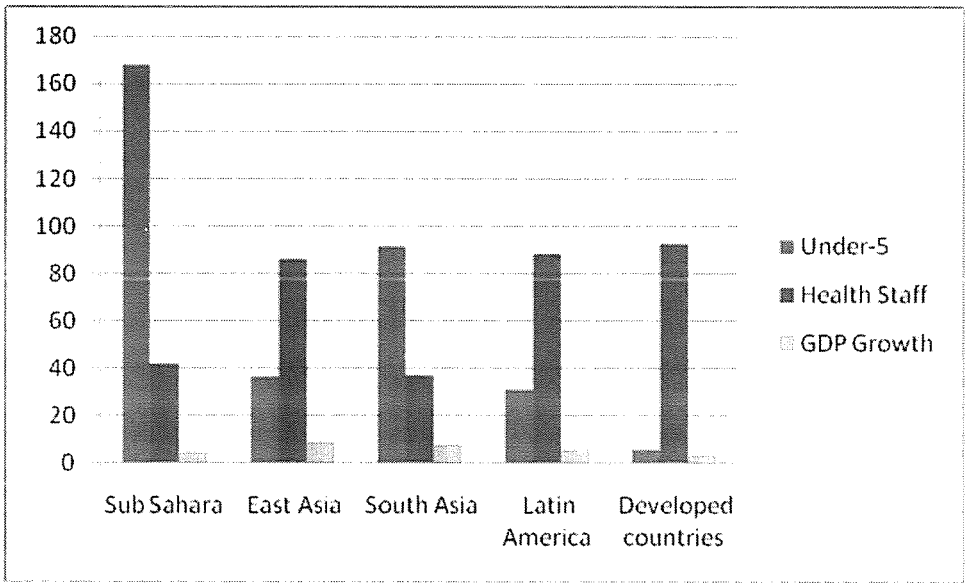
[20] McGuire (2005, P. 14)

[21] McGuire (2005, P. 17)

seems to have higher impact than presence of skilled staff at the time delivery, but nonetheless, it also has significant effect.

Analyzing the data in Table 7 and Table 8, it can be seen that the under-5 mortality fell whenever there was an increase in the share of births attended increases. For instance, Malawi's share of birth attendance rose from 56 percent during 1995-2002 to 61 percent in 1995-2003; the under-5 mortality also fell down from 183 per 1000 live births in 2002 to 178 per 1000 live births in 2003. On the contrary, with the fall in share of births attendance for Kenya and Nigeria, child mortality rose in these two countries.

Graph 9: Under-5 mortality rate with respect to skilled Health Staff and GDP growth rate



Data source: World Development Indicators Database 2004

The graph above depicts the relationship between health staff and child mortality by observing under-5 (per 1000), births attended by skilled health staff (in percent) and GDP growth (in percent). In this graph, Sub-Saharan Africa has the lowest percentage of births attended by skilled health staff, about 42 percent, but it has the highest under-5 mortality rate of about 168 per 1000. Whereas regions with more than 80 percent of births attended by skilled staff, have relatively low under-5 mortality rate. The effect of GDP growth rate is inconclusive from the graph. The observations within a continent and cross-continent are in line with the results

obtained by McGuire (2005) that births attended by skilled workers is rightful medical intervention to reduce child mortality.

3.4.2 Maternal and Infant programs

Besides birth attendance by a trained professional, it is also essential to understand how much accessibility and utilization of health service centers matters in order to reduce under-5 mortality. By accessibility, it means that there is at least one health service center which can be reached within a short time that is within half hour to one. Mosley and Chen (1984) state that utilization of health services is voluntary, even if freely available, and is critically dependent on household beliefs regarding health and residential distance from the facility. Health care centers in discussion are mainly focusing on prenatal care to reduce infant mortality (0-1year) and infant care, including immunization, to reduce child mortality (1-4year).

Again focusing on an economic analysis by McGuire (2005), the author regressed under-5 mortality on Filmer and Pritchett (1997) variables and also on an added variable called maternal-infant program access. In this analysis, McGuire[22] found that maternal and infant programs are closely associated with low under-5 mortality with t-statistic of 2.78 significant at the 1 percent level when this variable is added with the natural log of GDP per capita. The impact of maternal and infant program is stated as follows by McGuire:[23]

> "The substantive impact of maternal and infant program effort on under-5 mortality can be conveyed by setting the control variables to their means and estimating how much under-5 mortality would fall if the maternal and infant program effort were to rise by one standard deviation .....A standard deviation rise in maternal and infant program effort (from the 1995 mean of 21.1 to a level of 32.6) would reduce under-5 mortality by 18+/- 13 per 1000. By comparison, a one standard deviation rise in GDP per capita (from the 1995 sample mean of $2437 to $4276) would reduce under-5 mortality by 20 +/- 12 per 1000."

From the above passage, we can conclude that maternal and infant program are as strong as GDP per capita in reducing under-5 mortality.

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[22] The findings refer to Table 2 in McGuire (2005, P. 13)

[23] McGuire (2005, P. 14)

The underlying intuition regarding accessibility and utilization and child mortality is that if health centers are accessible than it paves a way to reduce child mortality because children can be taken to those centers for immunization for diseases like measles and malaria and can also get treatment for respiratory and diarrhoeal infections. The mentioned diseases are considered as leading causes of child mortality (Table 1 P. 8). Having access to health service is successful only if parents utilize those services to improve and maintain a healthy life for their children. The analysis above does establish the point that accessibility and utilization of health services are essential medical interventions to reduce child mortality.

3.5 Education

Education is one of the main determinants of child mortality. It has significant negative effect on child mortality. This section will discuss how an increase in education for both male and female affect child mortality. It is observed that the effect of education is direct and indirect. The indirect effect is through household income, that is, one more year of education will have positive effect on household income. This effect is more likely to be true for increase in male education, but might not be true for females if females are not allowed to work. There is a direct effect of education on child mortality as more education will make mothers aware of various diseases affecting children and also of proper treatment.

Education impact child mortality through various mediums and the most significant affect of education is on health status of a household. Filmer and Pritchett (1997) define health status as a function of income, female education and income distribution. Farah and Preston (1982) suggest that female education can provide a potent and cost-effective mean of reducing child mortality. They argue that "the improvement in child mortality associated with an added year of parental schooling is much greater for mothers than for fathers. Since father's education would be more closely associated than mothers with household income, the results suggest that education is working principally through other routes to child care and health practices."[24] It has also been suggested in other studies (Filmer and Pritchett, 1997, Pritchett and Summers, 1996, and Mosley and Chen, 1984) that female education has higher association with household behavior towards health and child care than male education. Hence, parental education has both direct (through

[24] Farah and Preston (1982, P. 370)

improvement in health and child care) and indirect (through effect of male education on income) effect on child mortality.

Filmer and Pritchett (1997) found in their economic model that female education is a highly significant at one percent significance level and after further data analysis, found that having a primary education will reduce child mortality by 26.2 percent and addition of secondary education to primary will reduce child mortality by 35.8 percent (Table 9). The results are based on 45 developing countries where 22 countries are from Sub-Saharan African countries. Similar results were found UNIECF (2006) study in Nepal where they found that child mortality is 64 percent higher for mothers with no education than mothers who have at least primary education. These results are in line with Farah and Preston's (1997) finding, data mainly based on Sudan, that "each additional year of schooling is associated with a proportionate reduction of 0.036 in the proportion dead among children, so that five years of maternal schooling is expected to reduce child mortality by 18 percent."[25]

Table 9: Mean (standard deviation) under-5 mortality by education level of the mother: DHS

	Mothers with no schooling	Mothers with primary schooling	Change (percent)	Mothers with secondary schooling	Change (percent)	Number of countries
East Asia Pacific	119.0 (40.3)	69.9 (18.1)	41.3	39.2 (16.0)	43.9	3
Latin America and Caribbean	110.9 (52.5)	79.3 (43.1)	28.5	49.4 (26.1)	37.7	10
Middle East and North Africa	94.5 (34.3)	62.1 (14.7)	34.3	41.4 (15.6	33.3	6
South Asia	127.7 (41.5)	84.8 (29.9)	33.6	70.9 (22.9)	16.4	4
Sub-Saharan Africa	179.8 (60.8)	139.9 (43.0)	22.2	87.5 (24.0)	37.5	22
All	144.4 (62.8)	106.5 (49.9)	26.2	68.4 (30.1)	35.8	45

Source: Filmer and Pritchett (1997)

The intuition behind the direct negative effect of female education is that if woman of a household is educated, then she has better knowledge as to the importance of visiting health centers at the time of delivery, so that they can be attended by trained professional, and for child

[25] Farah and Preston (1982, P. 372)

care. Child care implies that mothers have better understanding as to what precautions to take to avoid children from falling sick. That is, mothers know when to take children for immunization, what precautions to take to protect them from leading causes (Table 1, P. 8) of child mortality; malaria and infectious and diarrhoeal diseases. The study by McGuire found that there is high correlation between births attended by skilled staff and mean years of female education (+0.74) and also between female education and maternal-infant programs (+0.54). GDP per capita and female education are found to be even strongly correlated (+0.72). According to McGuire (2005), when birth attendance by skilled worker is added, the magnitude and precision of female education fell from 5.26 to 3.47 but it is still significant at one percent significance level. Similarly when maternal-infant programs access is added, the magnitude and precision of the coefficient female education fell from 2.88 to 1.89 but forcing it to become insignificant. It is evident through all the studies that female education is a crucial determinant of child mortality. Mosley and Chen (1984) found the same results and infer that many determinants of child mortality may be directly influenced by a mother's education to radically alter chances for child survival. A study by UNICEF (2006) in Nepal also found the same results as McGuire (2005) and Mosley and Chen (1984).

Farah and Preston (1982) found in Sudan that if women belong to a higher class or live in urban areas and who are from administrative or professional classes have lower mortality levels among children than women who are born in farming class or those who live in rural areas. However, they also found that women who are in the labor force have higher mortality among children than housewives because a mothers outside work may result in child neglect or care by a less skilled sibling. But, child mortality is not higher for mothers from wealthy families because they can afford skilled and attentive nursemaid (Mosley and Chen, 1984). Their analysis showed that child mortality among working women was 27 percent higher in Khartoom and 10 percent higher in all of Sudan.

As mentioned above, parental education has both direct and indirect effect on child mortality. Direct effect is through female education that affects accessibility and utilization of health centers and the indirect effect is through the effect on income of both parental educations. Fathers' income tends be to of higher influence than mothers. Degree of impact of male and female education on income depends on the structure and culture of a country. Income is a

variable which is used to determine health status of a household and is considered to be significant in reducing child mortality. Income is elastic to child mortality, so an increase in income will have negative effect on child mortality. Below is a table which shows income elasticity of infant mortality.

Table 10: Income Elasticity of Infant Mortality Estimated Using Various Length Differences

Period	**Without Education**	**With Education**
Five Year Differences	-0.15	-0.12
Decades	0	0
60 to 70	-0.25	-0.21
65 to 75	-0.22	-0.17
70 to 80	-0.23	-0.11
75 to 85	-0.21	-0.17
80 to 90	-0.27	--
Average	-0.24	-0.165
Two Decades	0	0
60 to 80	-0.32	-0.201
70 to 90	-0.37	--
Average	-0.345	--
Three Decades	0	
60 to 90	-0.43	--

Source: Summers and Pritchett (1996)

The data is from 1990, but it gives some indication as to how income elasticity changes when education is included. Even though income elasticity on infant mortality decreases with education, it still plays significant role in reducing infant mortality. The able above also indicates that the effect of income change is more in long-run than in short-run. For shot time differences such as five year, the income elasticity estimate is -015. But as the time differences increases, the income elasticity also increase to -0.24 (a decade), -0.32 (two decades), and -0.43 (three decades). This observation is also true when education is included. One possible reason for this decline in elasticity could be that education in itself a significant determinant of infant mortality. Infant and child mortality are highly correlated (estimate of +0.93), so child mortality (1-4 years) results are identical with those of infant mortality (0-1 year). The assumption behind parental education, especially fathers, is that "one additional year of husband's schooling reduces infant mortality by about 5 percent, again consistent with an income elasticity around -0.2 or

higher"[26]The underlying theory behind this statement is that one more year of fathers schooling will imply advances in work which is associated with increase in income. Since income is a crucial determinant of child mortality (discusses above), father's education also becomes essential parameter to consider when focusing on child mortality.

An individual's occupation is based on the level of education acquired. Seven or more years of schooling is associated with "Professional or Clerical" jobs, while "Skilled and Unskilled labor" is associated with one to three years of schooling. A father's education level is strongly correlated with occupation and therefore, with household income (Mosley and Chen, 1984). The table below, taken from Pritchett and Summers (1996), shows how child mortality is related to fathers' education and occupation.

Table 11: Median Ratio of Children's Mortality Rates at Various Ages for Different Categories of Husband's Education and Occupation from Household Surveys in 24 countries

	Neonatal (0-1 month)	**Post Neonatal (1 month-1 year)**	**Childhood (1-5 years)**
Husband's education 7 or more years versus 1-3 years	0.63	0.60	0.49
Husband's occupation "Professional or Clerical" versus "Skilled and Unskilled Labor"	0.68	0.69	0.55

Source: Summers and Pritchett (1996)

Even though the data used in Table 11 is from mid 1980s, we can see the trend that mortality rates are, on average, lower for groups with higher education. Father's education may also affect preferences and choices of child care services and consumption of goods, especially if the mother is less educated.

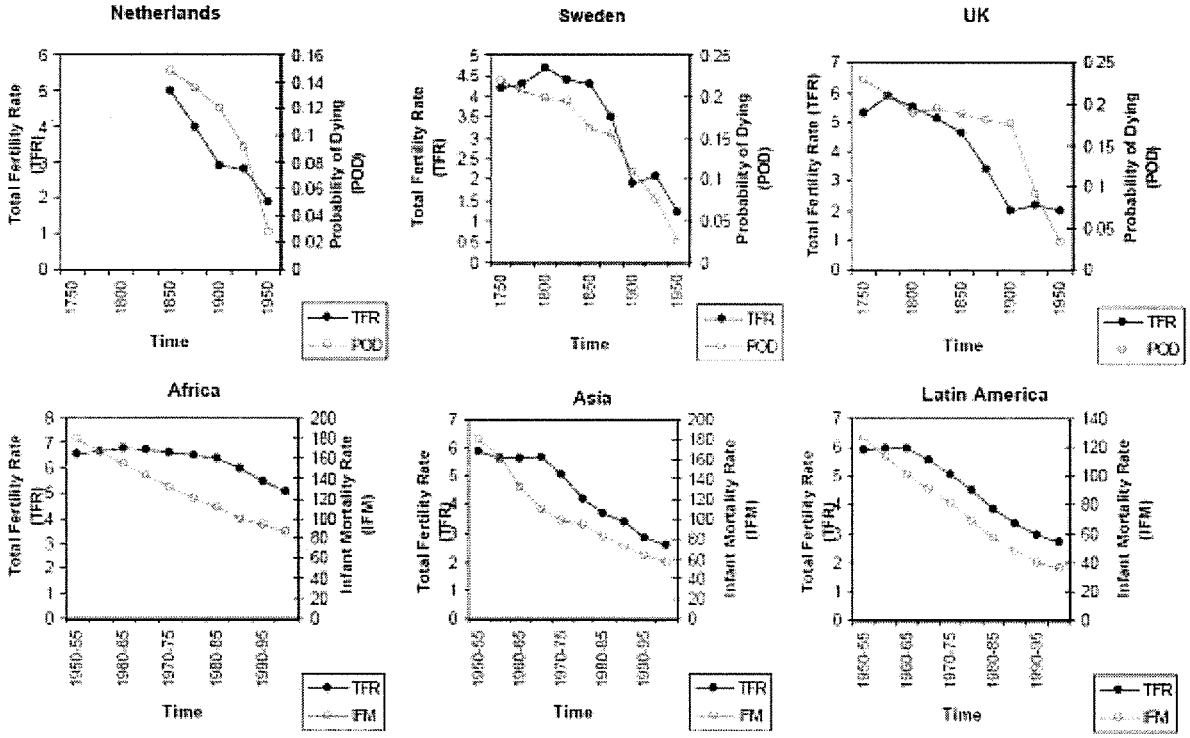
4 Child Mortality to Economic Growth

So far, this paper has studied the link from economic growth to child mortality; is the reverse link also true? Does reducing the child mortality rate have any effect on the economic growth of a country? Kalemli-Ozcan (2002) states that "decline in child mortality working through the

[26] Pritchett and Summers (1996, P. 862)

channels of education and fertility promotes economic growth."[27] This study relates rate of survival with population growth and population growth with income per capita. Kalemli-Ozcan (2002) and Strulik (2003) found that if child mortality is high, fertility rate is also high because parents tend to have more children with full knowledge that some of their children might die. The graphs below show the relationship between total fertility rate and mortality in developed and developing countries. It can be seen in the graphs that in developed countries where the mortality rate is low, total fertility rate are also low, whereas in developing countries, both the mortality and total fertility rates are high. In Africa, total fertility rate decreases slightly as mortality rate declines.

Graph 10: Fertility and Mortality



Source: Kalemli-Ozcan (2002)

There are few studies analyzing the causation from child mortality to economic growth. The focus in those studies is on the demographic factors which are affected by child mortality. These

[27] Kalemli-Ozcan (2002)

studies explicate the impact of decline in child mortality on the demographic factors and also on the economic growth.

4.1 Survival Rate and Population Growth

As mentioned above in our discussion on the impact of child mortality on the economy, fertility rate was found to be one of the factors that is significantly affected by the level of child mortality. Fertility rate is not directly affected by child mortality but rather by parent's decision on low survival rate and expenditure associated with children. It is argued that if the survival level is low then fertility increases. It is especially true for low income developing countries. If child mortality is high, parents from the bottom-tail of the income distribution see the cost of surviving children to be higher than the cost of having more children, and hence they prefer to have more children than to invest on the quality of their children. The decision to conceive more children is just a precautionary step for parents. The intuition behind this decision is that surviving children can be put into labor market so that children can co-finance the expenses of having them with their parents. This gives rise to child labor. Population grows rapidly if fertility rate increase and survival rate is low. Now the question is whether the decline in child mortality increases or decreases fertility and population? Studies by Kalemli-Ozcan (2002) and Farah and Preston (1982) argue that high level of survival is associated with decline in population growth if return to education is high enough since population growth is a concave function of survival probability.

Farah and Preston (1982) derives two solutions for increase in the survival level. One is interior solution where rise in survival rate will result in fall in population growth, and the other is corner solution where rise in survival rate will result in increase in population growth. The main assumption at interior solution is that parents can afford child quality expenditure depending on child mortality rate. That is, if child mortality rate is uncontrollably high and child bearing cost is low that at an interior solution parents may not have enough to ensure child quality. Hence, parents prefer to partly substitute expenditure on child health by fertility. But, as survival rate rises considerably, "at interior solution, where child quality is affordable, the main motive for childbearing is the compound of enjoying child leisure and spending income on child

quality."[28]This change in parent's behavior will reduce fertility rate followed by decline in population growth.

On the other hand, the main assumption for corner solution is that parents can't afford child quality expenditure. At the corner solution, parent's decision is mostly based on child cost rather than survival rate. Farah and Preston (1982) argued that "increasing child survival reduces net cost of producing a surviving child and induces parents to want a larger family. Income from child labor increases and compensates a higher disutility of seeing children work. Consequently, parents increase child labor supply."[29]In this case, rise in survival rate will result in increase in fertility rate rather than fall and hence population growth also rises. Therefore, there is a relation between survival rate of children and population growth, but the exact effect will be identified once it is clear whether it's interior solution criteria or corner solution.

Income per capita is associated with positive human capita and negative population growth. According to Kalemli-Ozcan (2002), population growth is a hump-shape function of Income per capita. This implies that at low levels of income per capita population growth rises as income per capita rises, which leads to low income per capita due to dilution of resources. On the other hand, at high levels of income per capita population growth falls as income per capita rises. As discussed above, low child mortality leads to low population growth which in turn leads to rise in income per capita due to its association with population growth.

5 Conclusion

The purpose of this paper was to examine whether there exists a relationship between economic growth and child mortality. After thorough review of the existing literature, it can be concluded that there is a causal relation between economic growth and child mortality via socioeconomic indicators.

Income per capita, education, and income inequality are found to have negative effect on child mortality. Income per capita is found to be significant enough to explain about eighty percent of

[28] Strulik. (2003, P. 8)

[29] Strulik (2003, P. 7)

child mortality alone. It is found that increase in income per capita shifts parents focus from child quantity to child quality. This reduces child mortality by increasing private spending on health and education of children and by providing healthy environment to live in with proper nutrition. Income inequality is also found to be a key element in achieving high survival rate among children under age five since population belonging to bottom-tail of the income distribution has higher child mortality than top tail. Having low income inequality reduces child mortality as well but the impact of this variable is not as significantly as that of income per capita.

Parental education is observed to be consequential in reaching low child mortality. It is found that education affects child mortality both directly and indirectly. Direct negative effect is found through mother's education as educated women are found to be more aware of treatment and precautions needed to improve children lives. Male education is found to have significant negative effect on child mortality via income effect. It is observed that increase in income will result in increase in income and hence higher private spending on child quality.

Public Health spending is found not to be as significant as socioeconomic factors. It is found that increase in public spending on health does not result in decline in child mortality as basis health care needed by children is so inexpensive that they do not show up in the data of health spending. Attendance of health staff at birth, and accessibility and utilization of health services are found to be more significant in reducing child mortality than public health spending.

One of the major limitations of the studies is accountability and comparability of data. Every country has its own evaluation and monitoring process for socioeconomic indicators, therefore lack of standardization makes comparative and trend analysis difficult. Due to poor evaluation and monitoring process, the data in low development countries might be unreliable. There are very few studies on the causal relation between child mortality and economic growth. One of the possible directions for future exploration could be to develop econometric models to examine the affect of decline in child mortality on socioeconomic factors mentioned above and on economic growth.

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