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Health Expenditures and Health Outcomes in Africa

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Abstract

This paper provides econometric evidence linking African countries' per capita total as well as government health expenditures and per capita income to two health outcomes: infant mortality and under-five mortality. This relationship is examined, using data from 47 African countries between 1999 and 2004. Health expenditures have a statistically significant effect on infant mortality and under-five mortality. The magnitude of our elasticity estimates are in consonance to those reported in the literature. For African countries, our results imply that total health expenditures (as well as the public component) are certainly important contributor to health outcomes. In addition, we find that both infant and under-five mortality are positively and significantly associated with Sub-Saharan Africa. The reverse is true for North Africa. While ethnolinguistic fractionalization and HIV prevalence positively and significantly affect the health outcomes, higher numbers physicians and female literacy significantly reduce these health outcomes. These results have important implications for attaining the targets envisioned by the Millennium Development Goals. The data implications are also discussed.

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Comments are welcome; please send any communication directly to the authors.

I.   INTRODUCTION

The role of human capital in fostering economic development is well recognized in the literature. Thus, the justification for higher government expenditure on human capital development is often based on its impact on (a) individuals' lifetime incomes (i.e., the social rate of return) (see, for example, Anyanwu, 1996, 1998); (b) economic growth (Levine and Renelt, 1992; Mankiw el al., 1992; Barro and Sala-i-Martin, 1995; Barro, 1996a, b; and Sala-i-Martin, 1997; and (c) fostering economic development and poverty reduction in general (Romer, 1986; Lucas, 1988; Squire, 1993; Ravallion and Chen, 1997; Sen, 1999; and Schultz, 1999. Better health enhances the effective and sustained use of the knowledge and skills that individuals acquire through education (Schultz (1999)). Barro (1996b) further argues that better health can reduce the depreciation of education capital, and thus increases the favorable effect of education on growth. Arjona et al. (2001) find that although there is no clear impact of social spending on growth at the aggregate level, there exists a positive association between certain types of social spending (albeit excluding many forms of education and health outlays) and growth. A more recent study by Gyimah-Brempong and Wilson (2004) finds a positive and robust link between investment in health and growth in both sub-Saharan African and OECD countries.

As Bloom and Canning (2000; 2003) have shown, healthier individuals might affect the economy in four ways: (a) They might be more productive at work and so earn higher incomes; (b) They may spend more time in the labor force, as less healthy people take sickness absence or retire early; (c) They may invest more in their own education, which will increase their productivity; and (d) They may save more in expectation of a longer life—for example, for retirement—increasing the funds available for investment in the economy. Health is indeed closely intertwined with economic growth and sustainable development. There is evidence that investing in health brings substantial benefits for the economy. According to the WHO, increasing life expectancy at birth by 10% will increase the economic growth rate by 0.35% a year. On the other hand, ill health is a heavy financial burden. 50% of the growth differential between rich and poor countries is due to ill-health and life expectancy (see Commission on Macroeconomics and Health, 2001).

The UN Millennium Declaration was agreed to in 2000 by 189 countries, exemplifying an unprecedented commitment on the part of both rich and poor countries to attain improvements in human development by the year 2015. This commitment is summarized in the eight Millennium Development Goals (MDGs) that set targets in areas of poverty reduction, health improvements, education attainment, gender equality, environmental sustainability, and fostering global partnerships (UNDP, 2003). The eight goals are: eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; combat HIV/AIDS, malaria, and other diseases; ensure environmental sustainability; and develop a global partnership for development. This focus on MDGs has triggered critical debates on several issues, including the choice of policy options for attaining the MDGs and concerns regarding the lack of availability and reliability of data for monitoring MDG outcomes.

Under-five (child) mortality (U5MR), the probability of dying between birth and age five years expressed per 1000 live births, and infant mortality (IMR), the probability of dying

before age one expressed per 1000 live births, have been used as measures of children's well-being for many years. Infant mortality is also regarded as a sensitive indicator of the availability, utilization and effectiveness of health care, and it is commonly used for comparing health care systems (The Tribune, 2002), monitoring and designing population and health programs. Though U5MR had been declining (Figure 1), progress on the child mortality MDG (MDG4) lags behind all other goals.
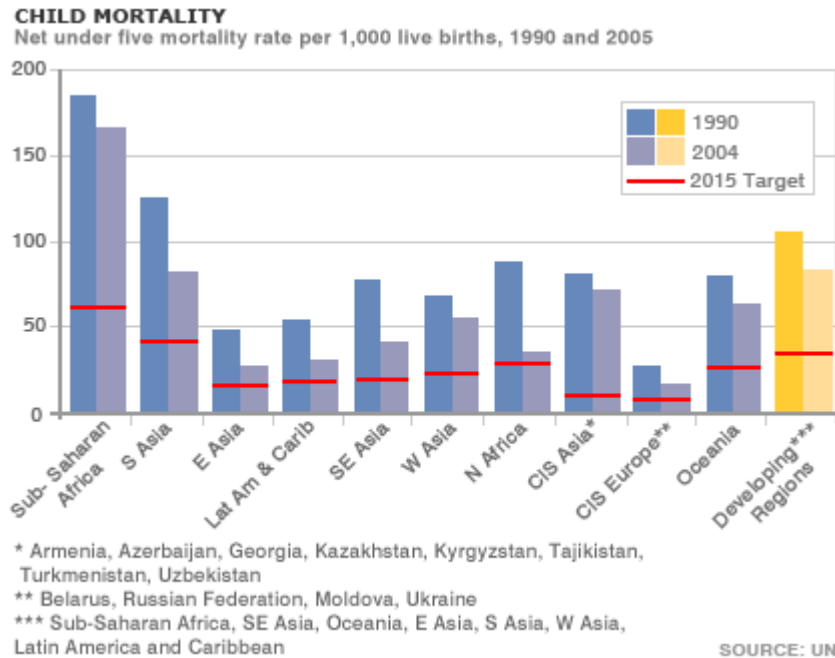
Figure 1: Declining Trend in Under-Five Mortality – But Still Highest in SSA
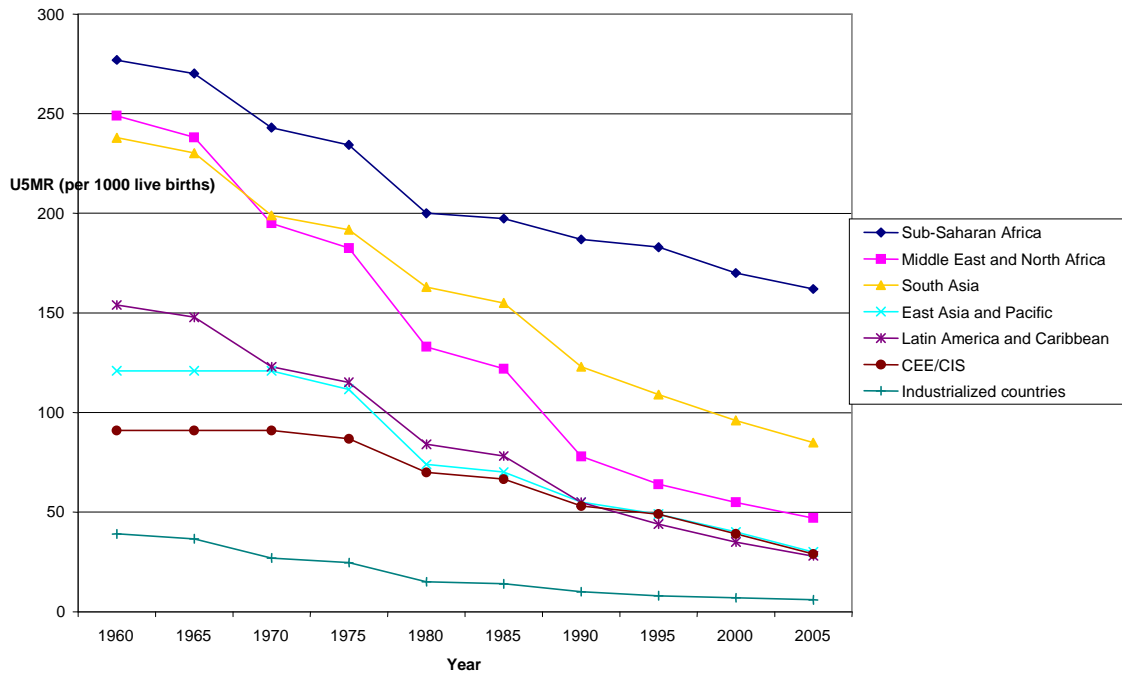
Source: UNICEF (2007)

While the majority of countries have reduced child mortality since 1990, progress has been insufficient to reach the MDG target—which requires an annual decline of 4.3 percent over the entire period. Only two regions, East Asia and Pacific and Latin America and the Caribbean, are close to achieving the MDG target. But even in those two regions, more than half the countries are off track. Progress has been particularly slow in Sub-Saharan Africa, where rates of infant and child mortality are increasing in some countries. Indeed, the gap between goal and reality is greatest in Sub-Saharan Africa where under-five mortality was 185 in 1990 and 163 in 2005 – far short of the target of 62 in 2015 (see Figure 2). Based on estimates through 2005, only 33 out of 147 countries (22 percent) in the developing world are on track to achieve a two-thirds reduction in the mortality rate. Unfortunately, every country in Sub-Saharan Africa is off track, and in some countries mortality rates have actually increased since 1990 (World Bank, 2007). In fact, estimates for 2006 indicate that Sub-Saharan Africa has the highest child mortality rate at 160 per 1,000 (UNICEF, 2007)(Table 1).

Figure 2: Regional Overview of the Child Mortality Rates, 1990 and 2005

CHILD MORTALITY
Net under five mortality rate per 1,000 live births, 1990 and 2005

* Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan
** Belarus, Russian Federation, Moldova, Ukraine
*** Sub-Saharan Africa, SE Asia, Oceania, E Asia, S Asia, W Asia, Latin America and Caribbean

SOURCE: UN

Nearly five million under fives from sub-Saharan Africa died in 2006 out of nearly 10 million children under five who died in 2006 globally. The highest rates of child mortality are found in West and Central Africa (Figure 3), where more than 150 of every 1,000 children born will die before age five compared to an average of six in the wealthy countries of North America, Western Europe and Japan. Two sets of countries have worsened outcome: those in Southern Africa that have been hit hardest by AIDS, and those that have been at war recently, like Congo and Sierra Leone. However, the experience of countries that have made rapid progress is also noteworthy, including in Eritrea which, despite per capita income of only US$190, cut child mortality in half between 1990 and 2005.

Table 1: Under-Five Mortality: Comparative Regional View

	Under 5 mortality rate			% change 1990-2006
	1960	**1990**	**2006**	
SUMMARY INDICATORS				
Sub-Saharan Africa	277	187	160	14
Eastern and Southern Africa	252	165	131	21
West and Central Africa	300	208	186	11
Middle East and North Africa	249	78	46	41
South Asia	238	123	83	33
East Asia and Pacific	121	55	29	47
Latin America and Caribbean	154	55	27	51
CEE/CIS	91	53	27	49
Industrialized countries	39	10	6	40
Developing countries	219	103	79	23
Least developed countries	276	180	142	21
World	184	93	72	23
Total for the 60 countries that account for 84% of all under-five deaths	**234**	**112**	**88**	21

	Under 5 deaths [in millions]		% change 1990-2006
	1990	**2006**	
Sub-Saharan Africa	4.1	4.8	-17
Eastern and Southern Africa	1.8	1.9	-6
West and Central Africa	2.4	2.9	-21
Middle East and North Africa	0.7	0.4	43
South Asia	4.7	3.1	34
East Asia and Pacific	2	0.9	55
Latin America and Caribbean	0.6	0.3	50
CEE/CIS	0.4	0.2	50
Industrialized countries	0.1	0.1	0
Developing countries	12.5	9.6	23
Least developed countries	4	4.1	-2
World	12.7	9.7	**24**
Total for the 60 countries that account for 84% of all under-five deaths	**11.4**	**9.2**	19

Source: UNICEF (2007)

This success appears in large measure attributable to implementation of the integrated management of childhood illness and points to the serious need to strengthen policy coherence and improve donor coordination in the health sector. Morocco was another

country in which declines in the numbers of children dying was particularly marked in recent surveys.

Figure 3: Estimated Under-Five Mortality in 2006 – Highest in West and Central Africa (Million)
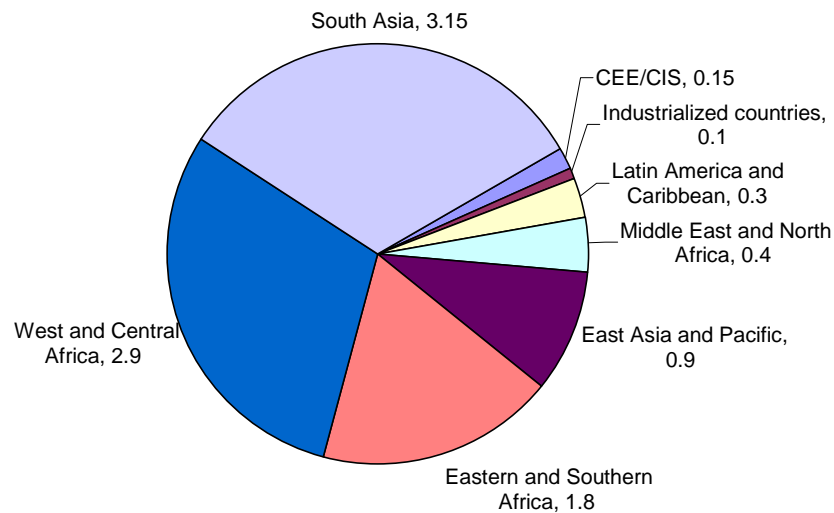
Source: UNICEF (2007)

The African Union Assembly at its 7th Ordinary Session, July 2006, in Banjul, The Gambia, reiterated its commitment to the MDGs by recommending concrete measures for scaling up efforts to meet the goals. African Ministers of Finance, Economic Planning and Development as well as the key sector Ministries have consistently placed the MDGs at the center of their Conferences and Meetings, particularly since 2005, after the renewed commitment by African leaders to achieving the MDGs.

September 2007 marks the midpoint on the road to 2015, the date set by world leaders for achieving the Millennium Development Goals (MDGs). This moment affords a solemn reminder to African governments and their development partners that time is fast running out and that the period for international commitment to meet the MDGs through needed investments and policies will soon be past (AU, ECA, and AfDB, 2007).

Against this background, public expenditure, being the most readily available policy instrument for provision of social services has come under increasing scrutiny in African countries. Both the introduction of Poverty Reduction Strategy papers (PRSPs) and the enhanced HIPC are partly meant to identify social priority areas to enable governments to better target and monitor their resources, especially external assistance funds made available explicitly for social purposes. These initiatives have been further boosted by the outcome of

the G-8 Gleneagles meeting in 2005 and the subsequent introduction of the Multilateral Debt Relief Initiative (MDRI). Thus, increasingly, the focus of international development assistance to Africa has turned to improving social conditions in the continent. This has led to greater interest in government social expenditure policies and how they affect social priority areas.

A crucial issue in this regard is the role of public policy in helping countries meet the MDGs. In most countries, the public sector plays a dominant role in providing the health and educational services necessary to build human capital. As such, the impact of spending on social indicators that might help countries meet the MDGs (via their salutary effects on economic growth) is of great interest. While positive externalities or market failures may justify the involvement of the public sector in these areas, this does not, in itself, indicate that higher spending *per se* is the most effective or the only policy intervention for helping meet the MDGs. The growing focus on the Millennium Development Goals (MDGs) has further highlighted the importance of making tangible progress in indicators of human capital measured on the basis of key health and education indicators.

With the introduction of the heavily Indebted Poor Countries (HIPC) Initiative in 1996 and its enhanced version in 1999, greater priority has been placed by aid providers on visibility and timely improving social sectors in recipient countries, while still emphasizing economic growth as indispensable for raising living standards across all income levels (Lopes, 2002). The reality of Africa (especially sub-Saharan Africa (SSA)) contributed to this new combined approach, since it is the region of the globe where economic growth and social conditions have improved the least in spite of all the international efforts on its behalf.

The causal relationship between health expenditures and health outcomes continues to attract the attention of many. However, despite decades of intensive study, there is no general consensus regarding the effectiveness of monetary health inputs for health outcomes. In particular, papers that summarize the debate on the effects of health expenditures often advocate conflicting views.

On the other hand, while the rising cost of the health care system in Africa has been a hot topic of discussion, relatively little attention has been placed on the relationship between spending on health and health outcomes in the continent. This is surprising, since along with ever-increasing health expenditures comes the need to evaluate their effectiveness. Did past expenditure on health affect the health outcomes of African children and infants in any way? Are increases in expenditure needed to improve the health outcomes of the African children and infants? These are questions that can only be answered by studying the relationship between health outcomes and health expenditures in Africa.

The aim of this paper therefore is to explore whether differences in the resources allocated to health (total and public) can explain differences in under-five (child) and infant mortality rates across African countries. The paper attempts to shed light on the effectiveness of health expenditures (total and public) by examining the effect of per capita total and public health expenditures the two health outcomes. This helps us to draw relevant policy conclusions. For that purpose, a regional panel data set was put together for econometric testing, using per capita total health expenditure and per capita government (public) health

expenditure for the period, 1999-2004 for which consistent and more comprehensive data is available. On the basis of the evidence from these tests, conclusions are drawn on the relative relevance of health expenditure for policy-making purposes.

The remainder of the paper is structured as follows. In Section II, a review of the existing literature is provided. In Section III, an explanation of the model and data is given. Section IV provides the empirical results. Section V concludes the paper with the policy implications.

II. THE LITERATURE REVIEW

Conceptually, a healthy person cannot only work more effectively and efficiently but also devote more time to productive activities. Based on microeconomic evidences, Strauss and Thomas (1998) argue that health explains the variations in wages at least as much as education. Research at the macro level can better capture the potential externalities of health sector interventions, and the existing studies are supportive of the positive contribution of health capital to growth. Bloom and Canning (2003), Bloom and Canning (2004), and Gyimah-Brempong and Wilson (2004) find that health capital indicators positively influence aggregate output. They find that about 22 to 30 percent of growth rate is attributed to health capital, and improvements in health conditions equivalent to one more year of life expectancy are associated with higher GDP growth of up to 4 percentage points per year.

However, African health systems face huge financing deficits. Compared to a global average of 5.4 percent of GDP, current government spending averages 2.5 percent of GDP and falls far short of that needed even to provide basic care. While spending on health care in high-income countries exceeded US$ 2,000 per person per year, in Africa it averaged between US$ 13 and US$ 21 in 2001 (Commission for Africa, 2004). The Commission for Macroeconomics and Health (2001) recommended that spending for health care in sub-Saharan Africa should rise to US$ 34 per person per year by 2007, and to US$ 38 by 2015, which represents roughly 12 percent of GNP. This is the minimum amount needed to deliver basic treatment and care for the major communicable diseases (HIV/AIDS, TB and malaria), and early childhood and maternal illnesses. Similarly, some argue for a massive scaling up of public health and other social sector expenditure (Sachs, 2004).

But, funding for health services is often cited as a major constraint for governments to be good stewards of health systems in their countries. Yet, in most cases, the data to support such claims is lacking. Making progress on a variety of health policy questions requires good national data on the sources and uses of funds in the health system, preferably comparable across countries. With such data, it is possible to begin answering questions such as what level of funding is needed in particular health contexts.

Such data can be useful to decision-making in many different contexts. For example, many African countries are asking whether they are spending too much on health. Donor countries that provide grants or loans are asking questions about how much of those funds are being allocated to health and whether they are being used effectively. Middle per capita income countries ask how much they can afford in terms of better health services, and how best to allocate their limited funds; while many of the poorest countries need to document the gap between available resources and those required to provide basic health care. What

stakeholders most need is evidence that can equip them with the tools for policy-making and advocacy. At the national level, it clarifies how much they are paying, and who is actually benefiting from the services provided. This empowers governments by helping them to make decisions based on evidence.

Key questions for policy and health sector strategy are how far public expenditure has been instrumental in bringing about the progress in health status experienced in developing countries over the five decades, and what programs have been particularly effective (Roberts, 2003). To answer the first of these questions research has sought econometric estimates of strength and significance of the factors most likely to influence health status based on reduced form versions of a generally agreed understanding of the determination of health outcomes. At the micro level, the proximate determinants of the health status of members of a household are usually taken to be: (a) personal and socio-cultural (household income, asset holding and access to insurance, income and asset distribution, other personal characteristics of household members, including lifestyle, sexual practices, and knowledge of good nutrition, diet, hygiene and health maintenance practice, genetic pre-disposition to illness); (b) geographical and environmental (location (urban or rural), access to clean water and sanitation, prevalence of communicable diseases and of environmental health hazards); and (c) health services (relevance, quality, availability, price and accessibility of public and private preventive and curative health services).

A growing literature in recent years has tried to examine the link between health expenditure and health outcomes especially as it affects under-five mortality and infant mortality. The available studies so far document a range of effects – from no impacts, to limited impacts, and to impacts on only specific interventions.

Early studies (as summarized by Musgrove in 1996) find no evidence that total spending on health has any impact on child mortality. Filmer and Pritchett (1997) present empirical evidence that suggests that public spending on health is not the dominant driver of child mortality outcomes. Income, income inequality, female education, and "cultural factors" such as the degree of ethnolinguistic fractionalization explain practically all of the variation in child mortality across countries. Based on these findings, policies that encourage economic growth, reduce poverty and income inequality, and increase female education would do more for attaining child mortality reductions than increasing public spending on health. Similar findings of lack of significance of public health expenditure have been presented by others (see Kim and Moody, 1992, Musgrove 1996). Filmer and Pritchett (1999) found that government health expenditures account for less than one-seventh of one percent variation in under-five mortality across countries, although the result was not statistically significant. They conclude that 95 percent of the variation in under-five mortality can be explained by factors such as a country's per capita income, female educational attainment, and choice of region. A number of other studies have linked changes in mortality rates in terms of resource use at hospital, managed care, educational status of parents , females and children, technological change (see also Filmer et al, 1997; Cutler, 1995; Geweke et al, 2003; Kessler and McClellion, 2000; McClellan and Noguchi, 1998; Mazunder 2007; Goldman and Smith, 2002; Glied and Lieras-Muney, 2003). Burnside and Dollar (1998) found no significant relationship between health expenditure spending and the change in infant mortality in low-income countries.

Using a model similar to that of Filmer and Pitchett (1997, 1999), Wagstaff and Cleason (2004) show that good policies and institutions (as measured by the World Bank's Country Policy and Institutional Assessment or CPIA index) are important determinants of the impact of government health expenditures on outcomes. In particular, as the quality of policies and institutions improves (as the CPIA index rises), the impact of government health expenditures on maternal mortality, under weight children, under-five and tuberculosis mortality also increases and is statistically significant. However, they conclude that the impact of government expenditures on under-five mortality remains not significantly different from zero.

A recent World Bank report includes an analysis of infant mortality and health expenditure using a panel of data for the Indian states during 1980-99 (World Bank, 2004: 45-50). This study finds no effect of health expenditure on mortality rates once state fixed effects and a linear time trend are included in the model. However, using data for 50 developing and transition countries observed in 1994, Gupta, Verhoeven and Tiongson (1999) find that health expenditure reduces childhood mortality rates.

Some recent studies have found a positive relationship between spending on health and health outcomes (Or, 2000a,b; Baldacci et al., 2002; Berger and Messer, 2002), but others did not find a significant relationship between the two variables (Filmer and Pritchett, 1999; Thornton, 2002). Still others, such as Baldacci et al. (2002), found that their results depend on the data set and/or estimation methods used. All these studies, however, did find a positive and significant relationship between health outcomes and real per capita income.

Similarly, a number of other studies find that the contribution of health expenditure to health status—as measured by infant mortality or child mortality—is either small or statistically insignificant (Kim and Moody (1992), McGuire et al. (1993), Musgrove (1996), Filmer and Pritchett (1997), and Filmer et al., (1998)).

Or (2001) studies the determinants of variations in mortality rates across 21 OECD countries between 1970 and 1995 and finds evidence of a weak statistically significant relationship between per capita health spending and health outcomes. According to the author, the absence of a strong statistical relationship may be due to model misspecification or may reflect the fact that at high levels of population health, the returns to increases in health spending are small.

Furthermore, some other studies have failed to identify strong and consistent relationship between health care expenditure and health outcomes (after controlling for other factors), whilst in contrast, socio-economic factors are often found to be important determinants of health outcomes (Nolte and Mckec, 2004; Young, 2001; St. Leger, 2001).

Deussing (2003), in another unpublished M.A. research paper, uses micro-data from the 1996 National Population Health Survey for Canada, and find that provincial government spending on health does not have a statistically significant impact on self-assessed health status.

The effects of public financing of health expenditures, insurance coverage and other factors on health outcomes are examined by Berger and Messer (2002) within health production models estimated using 1960-1992 data across 20 OECD countries. They find that mortality rates depend on the mix of health care expenditures and the type of health insurance

coverage. In particular, increases in the publicly financed share of health expenditures are associated with increases in mortality rates. These authors therefore conclude that, as countries increase the level of their health expenditures, they may want to avoid increasing the proportion of their expenditures that are publicly financed.

Nixon and Ulmann (2006) show that although health expenditure and the number of physicians have made significant contribution to improvements in infant mortality, health care expenditure has made relatively marginal contribution to the improvement in life expectancy in the EU countries over the period of the analysis covering 1980-1995. Also in a cross-sectional data covering 117 countries for the year 1993, Zakir and Wunnava (1997) find that government expenditure on health care as a percentage of GNP does not play a major role in determining infant mortality rates.

Anderson (1975), Leu (1986), Babazano and Hillman (1994) provide some evidence of a positive impact of public financing of medical care on overall mortality and morbidity rates. Using pooled cross-country time-series data, a small negative relationship between health expenditure and mortality rates is found in a study by Hitiris and Posnet (1992). But their study controls for few factors other than health expenditure.

Hadley (1982) shows a positive relationship between health expenditure and health using county-level mortality data in the United States. In Europe, there is also some evidence pointing to a positive relationship between health care input and health outcomes (Forbes and McGregor, 1984; Elola *et al.*, 1995).

Issa and Ouattara (2005) disaggregate health expenditure into private and public and divided the countries into two groups according to their level of development (income). Using a panel data on 160 countries their results show a strong negative relation between health expenditure and infant mortality rates.

The results from Gupta et al. (1999) show that health expenditure reduces childhood mortality rates, though the evidence is not so robust. Non-robustness as the authors acknowledged may be linked to the fact that the data on public health expenditure and mortality are unlikely to be comparable across countries. Secondly, non-robustness as suggested by Temple (1999) and Durlauf et al (2005) may be due to the fact that most of these studies suffer the problems common to cross-country regressions, particularly, unobserved heterogeneity that might be correlated with the variable of interest. Gupta et al. (2001) further provide evidence from 70 countries that public spending on health is more important for the health of the poor in low-income countries than in the high income countries, suggesting higher returns on health spending in the former countries compared with the latter group. Hammer et al. (2003) test the robustness of the determinants of infant and child mortality for a set of developing countries. The results of their study show that in addition to the level of per capita income, health and education variables are robust determinants as well.

Alves and Belluzzo (2005) estimate static and panel data models using census data from Brazil for the period 1970-2000 to investigate the determinants of infant mortality rates. The findings of their paper indicate that poor child health (in terms of mortality rates) in Brazil can be explained by the levels of education, sanitation and poverty (See also Meara, 2001; Currie and Moretti, 2003; Filmer, 2003).

Paxson and Scady (2005) show that infant mortality spiked (it was 2.5 percentage higher) during the Peruvian financial crisis coincident with a 30 percent fall in per capita GDP between 1987 and 1990. They show that public health expenditure fell by 58 percent in this period, its budget share falling from 4.3 to 3 percent. They therefore conclude that this, together with a decline in private health expenditure, is a likely explanation of the rise in infant mortality in this period.

A recent study of 81 countries covering mainly low income and middle income countries conducted by Gottret and Scieber (2006) find that a 10 percent increase in government health expenditure has a larger impact in reducing under-five mortality and maternal mortality than a 10 percent increase in education, roads and sanitation. Government health expenditure has as large an impact as income on under-five mortality but a smaller impact on maternal mortal. In addition, for a 10 percent increase in government health expenditure the decrease in maternal mortality is typically 1 percent point more than decrease in under-five morality.

Also Bokhari et al. (2006) provide econometric evidence linking a country's per capita income to two health outcomes: under-five mortality and maternal mortality. Their findings show that, the elasticity of under-five mortality with respect to government expenditures ranges from -0.25 to -0.42 with a mean value of -0.50. According to the authors, for developing countries, the result implies that while economic growth is certainly an important contributor to health outcomes, government spending on health is just as important a factor.

A few studies conducted in Sub-Saharan Africa where the world's poorest dwell on health care expenditure and outcomes have also shown mixed results both with within and cross-country data. Kebeke's (2003) study of rural Ethiopia show that the estimated expenditures on children are more correlated to child welfare than per capita household expenditures. Ssewanayana and Younger (2004) found that, in Uganda, increase in health care expenditures, particularly on vaccination, will impact positively on infant mortality in Uganda by 2015. According to them, increasing vaccination rate to 100 percent would have the largest and probably most cost effective, impact, reducing infant mortality by 16 deaths per thousand birth. They, however, observe that given the strong impact of basic health care services on infant mortality rates, and the provision of public health services stagnated in the 1990s.

Baldacci et al. (2003) and Gupta et al. (2002) find that social spending is an important determinant of health and education outcomes. These studies find that the effect of social spending on human development indicators is stronger in cross-sectional samples than when the time dimension is also added. They also find that education spending has a greater effect on social indicators than health outlays. The positive effect of social spending on social indicators is also supported by Anand and Ravallion (1993), Hojman (1996), and Bidani and Ravallion (1997). Gupta et al. (2003) also find a positive relationship between public expenditure on health care and the health status of the poor.

There is large literature on the determinants of international variations in health care spending in which income levels often play a central role (Gerdtham and Jonsson, 2000). Nixon and Ulmann (2006) provide a detailed review of 16 studies that have examine the relationship between health care inputs and health outcomes, using macro-level data. They also undertake their own study using data for 15 EU countries over the period 1980-1995. They concluded that health expenditure and the number of physicians have made a significant contribution to improvements in infant mortality.

Day and Tousignant (2005), among others, examine the relationship between health outcomes and health spending in Canada for the periods 1960-1997, 1950-1997 and 1926-1999 and conclude that although some causal relationships between a measure of the health status of the population and real per capita health expenditures were statistically significant, these relationships were not very strong. The authors indicated that their finding may be due to model misspecification or may reflect the fact that at high levels of population health, the returns to increases in health spending are small.

Crémieux et al. (1999) examine the relationship between health indicators such as infant mortality rates and life expectancy and total (public and private) per capita spending on health, using pooled time-series cross-section data for the ten provinces for the period 1978-1992. Crémieux et al. (2005a,b) estimate a similar model using data for the period 1981-1998, but disaggregated per capita health spending into three categories: public spending on drugs, private spending on drugs, and non-drug health care spending. Kee (2001), in an unpublished M.A. thesis, also uses pooled time-series cross-section data for the ten provinces for the 1975-1996 period. Similar to Crémieux et al. (1999), Kee regressed indicators of population health status (infant mortality rates, life expectancy, and age-standardized mortality rates) on a number of variables, including real per capita public expenditures on health. However, unlike Crémieux et al. (1999), who use a pooled generalized least squares estimation procedure, Kee uses instrumental variables estimation to control for possible simultaneity between health status and public spending on health. All three of these studies found a statistically significant relationship between health status and both health spending and per capita income.

Using Demographic and Health Survey (DHS) data, Wang (2002) investigates the determinants of health outcomes in low-income countries both at the national level, and for rural and urban areas separately. He finds that at the national level public health expenditure significantly reduces child mortality.

While Harttgen and Misselhorn (2006) find that access to health infrastructure is important for child mortality, socioeconomic factors are often found to be good determinants of health outcomes (Nolte and McKee, 2004:58; Young, 2001; St. Leger, 2001). Numerous studies (especially those using micro-data) show a close association between child mortality and socio-economic status (for example, Preston, 1975, 1985; Hobcraft et al., 1984; Hill, 1985; World Bank, 1993). Most indicators of socio-economic status used are income per capita, education, urban/rural residence, work status and household assets. For example, Preston (1975) demonstrate a negative relationship between income and mortality. Similarly, focusing on 28 developing countries mostly in Asia and Latin America, Hobcraft et al. (1984) find that mother's and husband's education; their work status and their type of residence are more or less associated with child survival. Increased socio-economic status – specifically, mother's level of education - is also found to be closely associated with improved child survival in Nigeria (Caldwell, 1979), Costa Rica (Haine et al., 1982), and in Nicaragua (Sandiford et al., 1995).

III. THE MODEL AND DATA

3.1 The Model

The econometric approach is based on panel data regressions in equations for under-five mortality and infant mortality rates. The specification is consistent with the literature and allows for the identification of the channels through which government expenditure and other policy interventions affect these health outcomes over time.

Health Outcomes Equation

This basic equation (in logarithmic form) examines the direct impact of health spending on health outcomes, as proxied by under-five mortality and infant mortality rates. The Under-five Mortality Rate (U5MR) is the number of deaths per 1,000 of total population. The Infant Mortality Rate (IMR) refers to the number of deaths per 1,000 live births. It generally reflects the level of mortality and the effectiveness of preventive care and the attention paid to maternal and child health.

$$Hea_{it} = \alpha_{1i} + \beta_1 \ln(Hea\exp_{it}) + \beta_2 \ln(Ethnicfrac_{it}) + \beta_3 \ln(Female_{it})$$
$$+ \beta_4 \ln(Urbanpop_{it}) + \beta_5 \ln(y_{it}) + \beta_6 P \ln(Physicians_{it}) + u_{it} \ .....(1)$$

where
Hea_{it} = Health outcome (under-five mortality or infant mortality rate);

α_{1i} = Regional/Country-specific effect;

$Hea\exp_{it}$ = Per capita health expenditure (total or government/public);

$Ethnicfrac_{it}$ = Index of ethnolinguistic fractionalization;

$Female_{it}$ = Female literacy rate;

$Urbanpop_{it}$ = Urban population, as a measure of urbanization;

y_{it} = GDP per capita in international dollars;

$Physicians_{it}$ = Number of Physicians (per 100,000 population); and

u_{it} = Error term.

In accordance with the literature reviewed earlier, health expenditure as an indicator of the volume of resources flowing into health is expected to have negative effect on under-five and infant mortality rates. thus an increase in health expenditure per capita implies a broader access to health care and services which helps to decrease under-five and infant mortality rates. Given the redistributive influence of public intervention, a positive correlation between public financing and health outcomes is expected. As Schuler and Weisbrod (2006) had stated, high "ethnolinguistic fractionalization" (symptomatic of discriminatory treatment of minorities), apart from increasing the likelihood of conflicts, reduces the provision of public goods (see also Roberts, 2003; Matuszeski and Schneier, 2006; Campos and Kuzeyev, 2007). Filmer and Pritchett (1997) had incorporated it in explaining human capital outcomes. By fractionalization, we mean the probability that two randomly chosen people from a population will be of different ethno-linguistic backgrounds. Thus, movement from

heterogeneity to homogeneity (decreasing fractionalization) results in better health outcomes and more efficient infrastructures. It is often used as a proxy measure of social capital in a country.

It is also argued that female literacy (also representing gender equality) is an important determinant of the health status of infants and children, as well as the population in general (see Baldacci et al., 2004; World Bank, 1993; Schulz, 1993). Indeed, in developing countries, women play a more important role in family health and sanitation quite apart from the fact that female education is positively associated with infants' health and negatively associated with fertility rates. Also, educated mothers are more likely to be aware of nutrition and their children's health (Gubhaju, 1986; Zakir and Wunnava, 1997; Currie and Moretti, 2003). A woman's socio-economic status has long been believed to affect her children's survival chances. Indeed, one of the most frequent explanatory variables in the literature has been mother's education. Studies have consistently found that the children of women with some education do better, though the thresholds of the effect vary between study populations. For example, Sastry (1997) reports that in Brazil, mothers with at least three years of schooling experience 32% lower mortality risk among their children than less educated mothers. In a study of several African countries, Madise *et al.* (1999) find higher levels of education, secondary and beyond, to be important to child health. Magadi (1997) reports that father's, not mother's, education is significantly associated with child health in Kenyan communities where the status of women is low. Maternal education is usually included not only for its face value, but also as a proxy for other characteristics of the mother, the household, and the community. For example, Curtis *et al.* (1993: 36-37) explain that they use mother's education "as a general control for socio-economic status and for knowledge of health-related matters".

Roberts (2003) has emphasized that geographical/demographic factors such as rural or urban location or percentage of population in these locations affect health outcome (see also Schultz, 1993; Baldacci et al. (2004). In addition, as Schulz (1993) had shown, mortality rate is higher among rural, low-income, agricultural households than in their urban counterparts because, among other reasons, access to health is typically better in urban areas just as the private cost of health (such as transportation costs) may be lower for urban households. On the other hand, per capita income, a proxy for national poverty or socio-economic status (standard of living), has been shown to be a crucial determinant of human capital outcomes (Baldacci et al., 2004; Roberts, 2003). Thus, Gupta et al. (1999) had stated that the population's health status improves as per capita incomes (capturing a tapering-off effect of GDP on mortality) rise, suggesting that increasing income would be associated with lower under-five and infant mortality rates. In addition, higher incomes lead to improved public health infrastructure such as water and sanitation, better nutrition, better housing and the ability to pay for health care (Pritchett and Summers, 1996; Cutler et al., 2006). According to basic economic theory, if everything else is held constant and if health care is a normal good, an increase in per capita income will lead to increases in the demand for health care. Income also increases the capacity of governments and other players to supply more and better health care and to improve access to health care through better infrastructure. Also, as Ricci and Zachariadis (2006) had noted, the number physicians (per 100,000 population), as direct medical input and as a vector of knowledge facilitating medical technology absorption and the adoption of best practices, is expected to lower under-five and infant mortality rates.

3.2 The Data

A panel dataset for African countries from 1999 to 2004 was compiled for the purposes of the paper (see Table 2 for a description of the data and Appendix II for the list of countries). All data series are annual data. Data on per capita GDP, health outcomes, total and government expenditure on health, female education, number of physicians, and urban population are taken from the World Bank's *World Development Indicators* (WDI), WHO (WHOSIS) and African Development Bank's databases; and data on the index of ethnolinguistic fractionalization is taken from Easterly and Levine dataset.

In this paper, health outcome is proxied by under-five and infant mortality rates; and health expenditure data are expressed as a per capita total health expenditure and per capita government health expenditure. We adopt a robust Ordinary Least Squares (ROLS) model as the baseline specification and provide results from robust OLS using lagged explanatory variables; robust two-stage least squares (R2SLS) to control for endogeneity and reverse causality; and fixed-effect estimator to control for measurement error and autocorrelation. Following Bokhari et al. (2006) and Burnside and Collier (1998), we observe that since income and government health expenditures are potentially endogenous, we need to instrument for these variables. Thus, for income we use the consumption–investment ratio of a country as an instrument because it is likely to be correlated with GDP per capita (our income measure) but not with under-five mortality or the infant mortality. Similarly, for health expenditures the instrument that we use is the military expenditures of the neighboring countries and membership of the franc zone.

In this study, two indicators will be used as measures of health status because they are the most widely used in the literature. These measures are the infant mortality rate (IMR), and the under-five mortality rate (U5MR). These indicators are consistently available for most African countries for the 1999-2004 time period.

The mean infant and under-five mortality rates of individual African countries are presented in Figures 4 and 5, respectively. Figure 4 shows that twenty countries averaged 100 and above deaths per 1,000 live births (infant mortality) during the period, with the worst being Sierra Leone, followed by Niger. With respect to under-five mortality rate, as Figure 5 shows, twenty four countries averaged over 150 deaths per 1,000 population during the period. Again, Sierra Leone was the worst performer, followed by Niger.

Figure 4: Scatter Plot of Mean Infant Mortality Rates in African Countries, 1999-2004
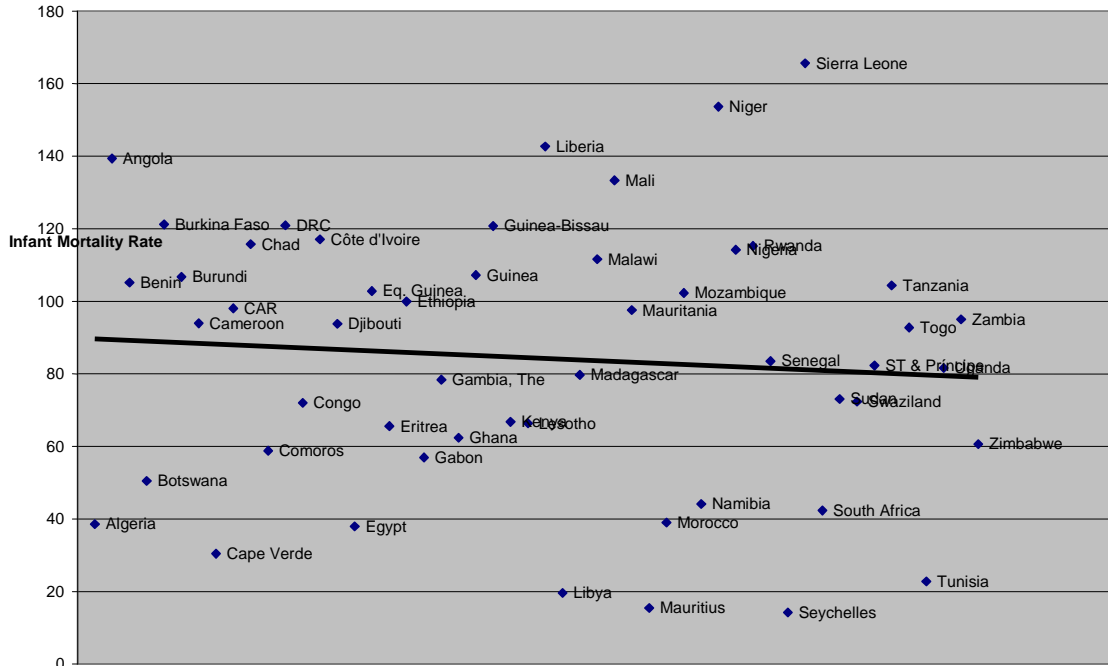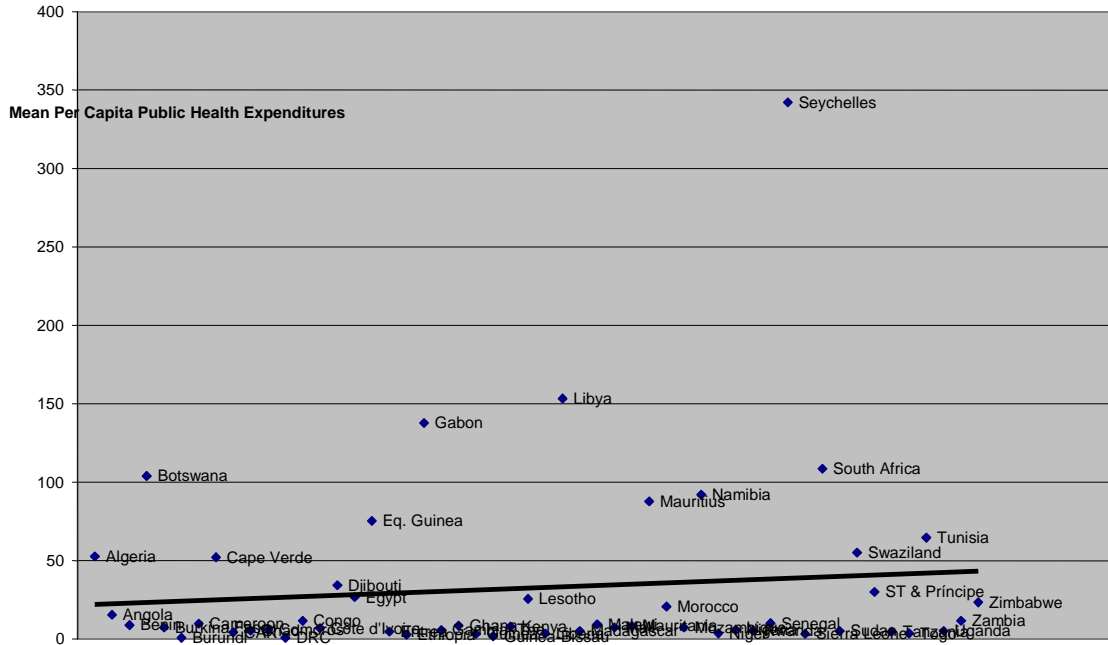

Source: Authors, using estimation data.

Figure 5: Scatter Plot of Mean Under-Five Mortality Rates in African Countries, 1999-2004
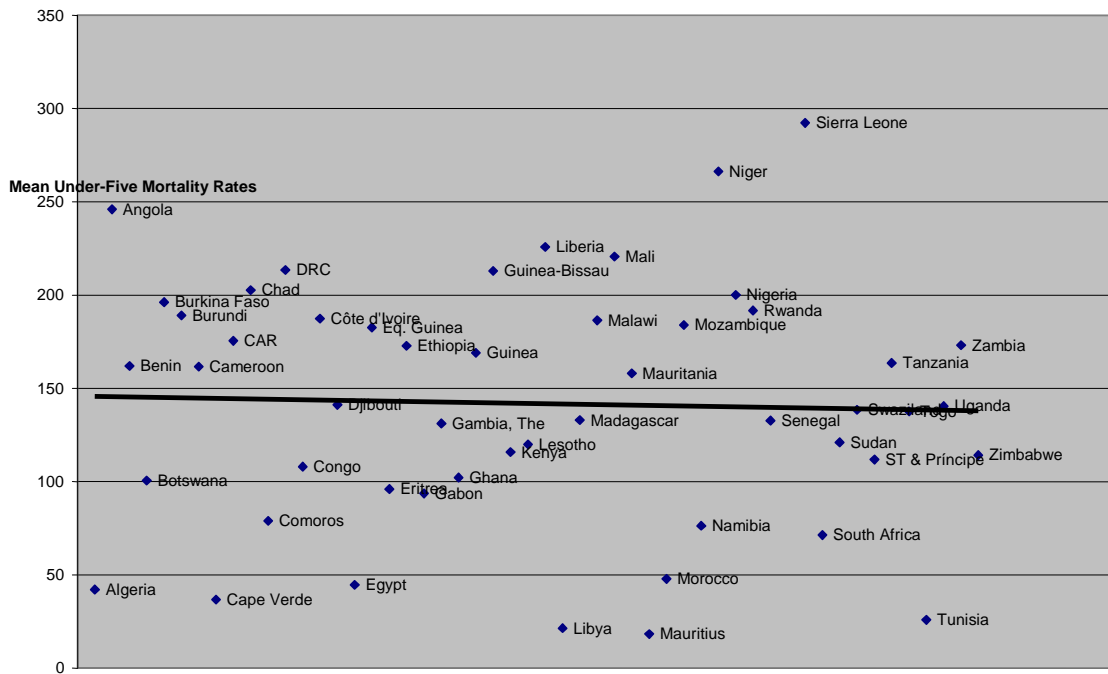
Source: Authors, using estimation data.

In the same vein, Figures 6 and 7, respectively, show the scatter plot of the mean per capita public health expenditure and mean per capita total health expenditure for the individual African countries. They show almost a reversal of the health outcomes.

Figure 6: Scatter Plot of Mean Per Capita Public Health Expenditures in African Countries, 1999-2004

Source: Authors, using estimation data.

Figure 7: Scatter Plot of Mean Per Capita Total Health Expenditures in African Countries, 1999-2004
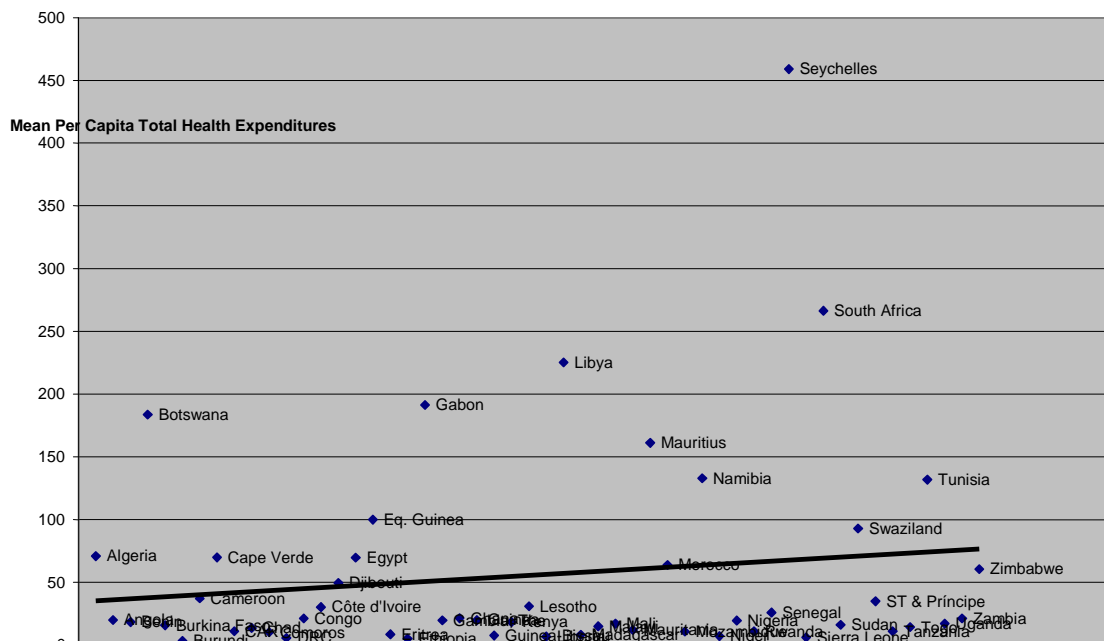
Source: Authors, using estimation data.

Summary descriptive statistics of the variables used in the empirical analyses are provided in Table 2. It shows that, on average, under-five mortality stood at 142 deaths per 1,000 population while for infant mortality the mean figure stood at 85 deaths per 1,000 live births. Mean per capita total health expenditure was US$55.76 dollars while mean per capita public health expenditure stood at US$32.64.

**Table 2: Variable Names and Descriptive Statistics**

Variable	Mean	Standard Deviation	Minimum	Maximum
Under-five Mortality Rate	141.86	64.10	17.13	299.86
Infant Mortality rate	84.81	35.89	9.9	168.44
Per Capita Total Expenditure on Health	55.76	85.79	2.7	534.4
Per Capita Public Expenditure on Health	32.64	58.82	0.3	402.5
Ethnic Fractionalization	64.78	24.23	4	93
Female Literacy	53.53	21.27	8.11	94.81
Physicians (per 100,000 population)	29.75	43.45	1.00	220
Urban Population	40.48	18.23	6.05	88.46
Gross Domestic Product Per Capita at International Dollars	1095.21	1621.56	84	8912

Source: Authors' estimations.

Before proceeding to the regression analyses, it is instructive to present bivariate relationships between key variables using simple scatter plots. Figures 8 to 11 show clear and

unambiguously negative relationship between per capita total and government expenditure on health on one hand and infant and under-five mortality rates on the other, respectively.

Figure 8: Scatter Plot of Mean Log of Infant Mortality Rates and Mean Log Of Per Capita Total Health Expenditures
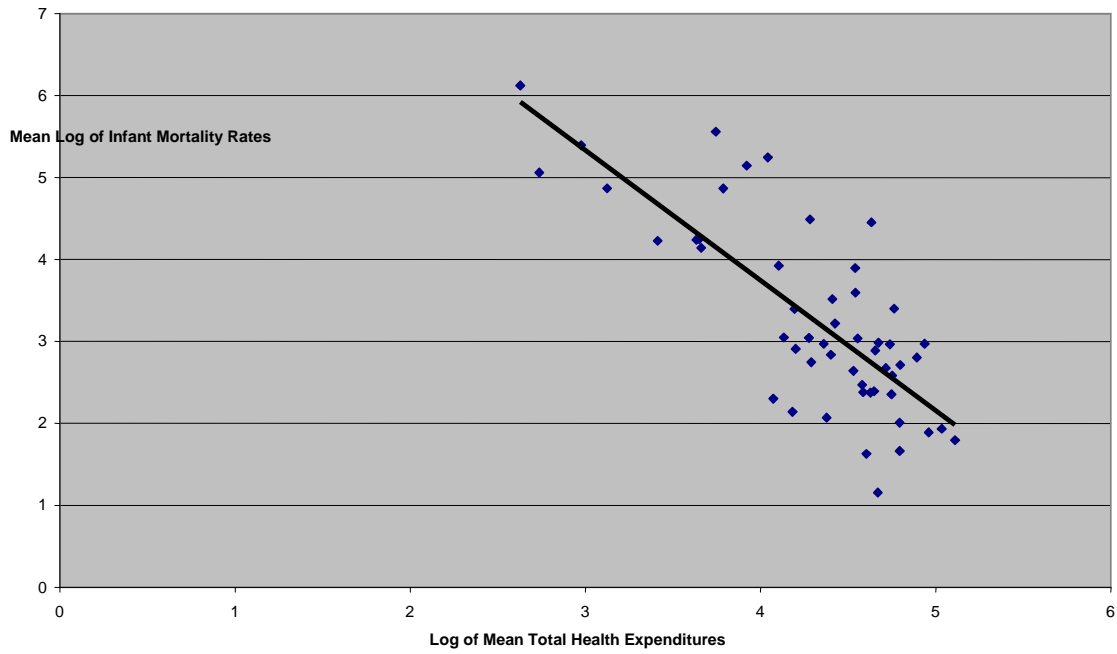
Source: Authors, using estimation data.

Figure 9: Scatter Plot of Mean Log of Under-Five Mortality Rates and Mean Log of Total Health Expenditures
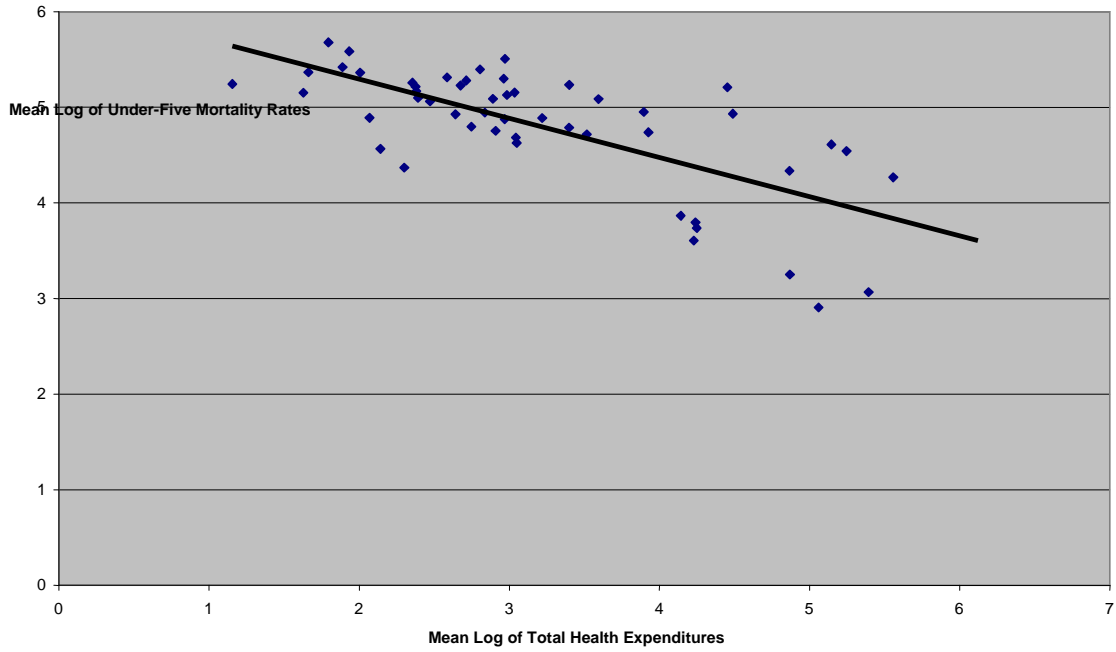
Source: Authors, using estimation data.

Figure 10: Scatter Plot of Mean Log of Infant Mortality Rates and Mean Log of Per Capita Public Health Expenditures

Source: Authors, using estimation data.

Figure 11: Scatter Plot of Mean Under-Five Mortality Rates and Mean Log of Per Capita Public Health Expenditures

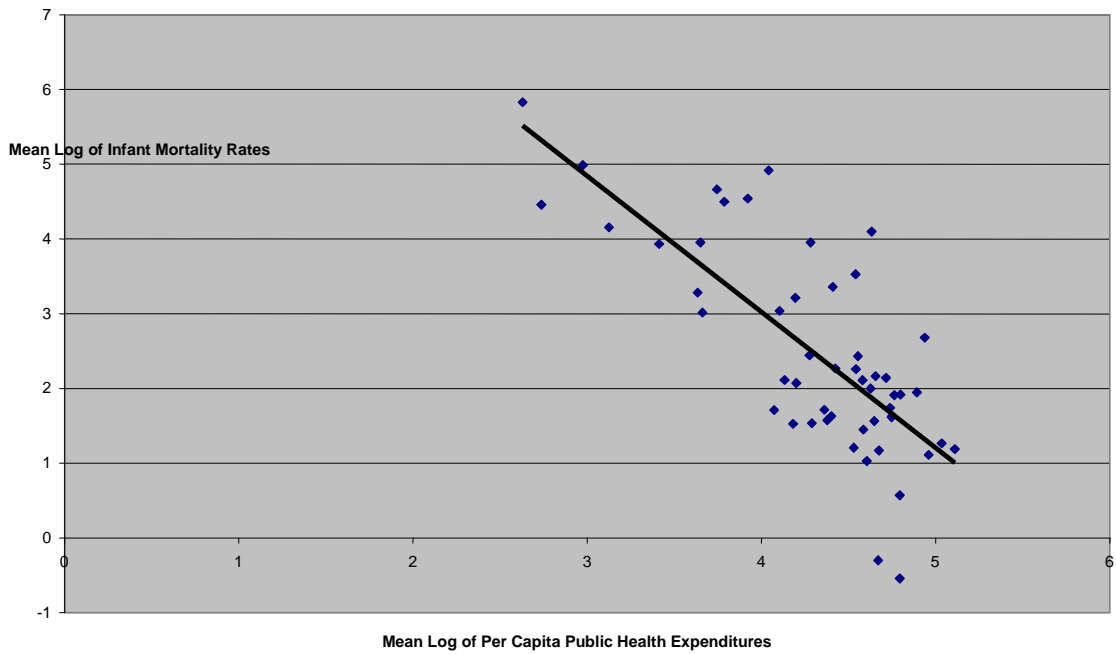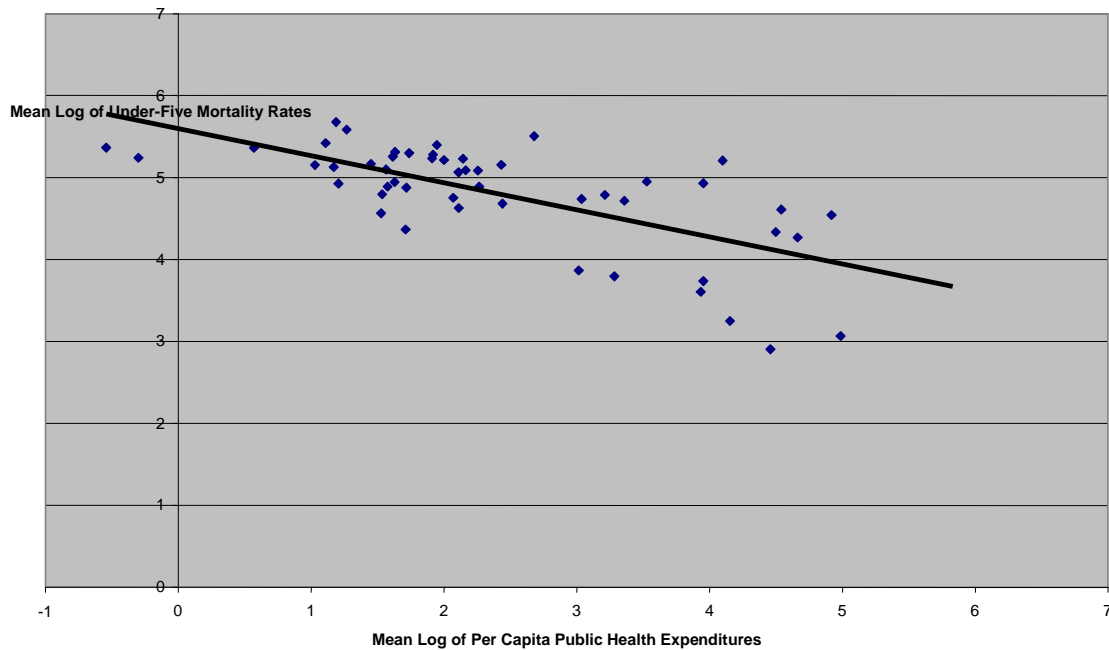Source: Authors, using estimation data.

IV. EMPIRICAL RESULTS

The results of the health outcome equations are presented in Tables 3 (under-five mortality rates) and 4 (infant mortality rates). The results from alternative specifications (used for the robustness tests) are also reported in the tables. In most cases the coefficients are statistically significant, and all equations have a good fit. Among the most salient results from the model are the following:

In both the under-five mortality and infant mortality rates in Africa, per capita total health expenditure and per capita public health expenditure are statistically significant. In the basic ROLS case, a 10 percent increase in per capita total health expenditure reduces under-five mortality rate by 21 percent while a similar 10 percent increase in per capita public health expenditure leads to a reduction of 25 percent in under-five mortality rate. Similarly, a 10 percent increase in per capita total health expenditure reduces infant mortality rate by 22 percent while a 10 percent increase in per capita public health expenditure leads to a reduction of 21 percent in infant mortality rate. These results are consistent with those of Bokhari et al. (2006), Issa and Ouattara (2005), Baldacci et al. (2004), and Or (2000). while those for secondary education are consistent with those of Gupta el at. (1999) though the coefficient estimates of the latter were much larger for 50 developing and transition countries.

Table 3: Regression Results for Infant Mortality Rate

Variable	Robust OLS [1,2,3]		Robust OLS (With Lagged Explanatory Variables)[1,2,3]		Robust 2SLS (IV) [1,2,3] (When both health expenditure and per capita GDP are endogenous)		Fixed-Effects[2,3]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Per Capita Total Health Expenditure	-0.22 (-3.51)**		-0.18 (-6.40)***		-0.42 (-1.40)		-0.22 (-4.13)***	
Public Per Capita Health Expenditure		-0.21 (-5.75)***		-0.17 (-7.90)***		-0.21 (-3.03)**		-0.21 (-5.90)***
Ethnic Fractionalization	0.08 (3.39)**	0.08 (3.26)**	0.09 (3.80)***	0.09 (3.84)***	0.09 (2.96)**	0.08 (3.49)***	0.08 (3.43)***	0.08 (3.53)***
Female Literacy	-0.18 (-5.16)***	-0.17 (-5.48)***	-0.15 (-4.01)8***	-0.13 (-3.63)***	-0.17 (-4.44)***	-0.16 (-4.62)***	-0.18 (-4.18)***	-0.17 (-4.20)***
Urban Population	-0.06 (-1.81)*	-0.06 (-1.59)	-0.04 (-1.52)	-0.03 (-0.86)	-0.06 (-1.11)	-0.08 (-1.35)	-0.06 (-1.08)	-0.05 (-1.06)
GDP Per Capita	0.07 (0.95)	0.10 (1.85)*	-0.0003 (-1.74)*	-0.0004 (-2.42)**	0.29 (0.96)	0.13 (1.05)	0.07 (0.97)	0.10 (1.68)*
Physicians	-0.06 (-1.57)	-0.09 (-2.70)**	-0.06 (-1.44)	-0.07 (-2.13)**	-0.09 (-2.22)**	-0.11 (-2.65)**	-0.06 (-1.83)*	-0.09 (-2.89)**
SSA	Reference Group	Reference Group	0.39 (4.55)***	0.36 (4.94)***	0.38 (5.76)***	0.35 (5.15)***	0.40 (6.50)***	0.39 (6.82)***
North Africa	-0.40 (-5.22)***	-0.39 (-6.00)***	Reference Group	Reference Group	Reference Group	Reference Group	Reference Group	Reference Group
Constant	5.36 (22.49)***	5.00 (23.48)***	5.10 936.91)***	4.87 (33.79)***	4.25 (4.26)***	4.55 (11.68)***	4.96 (19.66)***	4.61 (18.54)***
R-Squared	0.88	0.90	0.88	0.90	0.89	0.90	0.88	0.90
Number of observations	98	98	98	98	82	82	98	98
F-Statistic	98.39***	94.87***	133.18***	104.50***	124.04***	104.76***	89.15***	106.65***
P-value for Sargan's misspecification test							0.22	0.25

Notes: [1] Robust standard errors, adjusted for heteroscedasticity, are used. [2] T-statistics are reported in brackets.
[3] *** denotes statistical significance at the 1 percent level, ** at the 5 percent level, * at the 10 percent level using two-tailed tests.
Source: Authors' estimations.

Table 4: Regression Results for Under-Five Mortality Rate

Variable	Robust OLS [1,2,3]		Robust OLS (With Lagged Explanatory Variables) [1,2,3]		Robust 2SLS (IV) [1,2,3] (When both health expenditure and per capita GDP are endogenous)		Fixed-Effects [2,3]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Per Capita Total Health Expenditure	-0.21 (-2.59)**		-0.17 (-4.24)***		-0.63 (-1.83)*		-0.21 (-3.07)**	
Public Per Capita Health Expenditure		-0.25 (-4.97)***		-0.18 (-5.72)***		-0.22 (-2.73)**		-0.25 (-5.70)***
Ethnic Fractionalization	0.10 (3.28)**	0.10 (3.48)**	0.11 (3.52)**	0.11 (3.90)***	0.13 (3.04)**	0.10 (3.30)**	0.10 (3.24)**	0.10 (3.62)***
Female Literacy	-0.11 (-2.53)**	-0.10 (-2.39)**	-0.09 (-1.82)*	-0.06 (-1.29)	-0.12 (-2.26)**	-0.10 (-2.21)**	-0.11 (-1.90)*	-0.10 (-1.94)**
Urban Population	-0.10 (-1.93)*	-0.10 (-2.17)**	-0.09 (-2.32)**	-0.06 (-1.70)*	-0.08 (-1.11)	-0.11 (-1.45)	-0.10 (-1.35)	-0.10 (-1.60)
GDP Per Capita	0.06 (0.57)	0.16 (2.01)**	-0.0003 (-1.00)	-0.0004 (-1.56)	0.51 (1.48)	0.16 (1.15)	0.05 (0.57)	0.15 (2.04)**
Physicians	-0.09 (-1.96)*	-0.12 (-3.27)**	-0.08 (-1.93)*	-0.09 (-2.51)**	-0.12 (-2.66)**	-0.15 (-3.15)**	-.08 (-1.97)**	-0.12 (-3.12)**
SSA	Reference Group	Reference Group	0.63 (5.10)***	0.60 (5.64)***	0.64 (6.35)***	0.59 (5.41)***	0.62 (7.74)***	0.61 (8.41)***
North Africa	-0.62 (-5.29)***	-0.61 (-6.20)***	Reference Group	Reference Group	Reference Group	Reference Group	Reference Group	Reference Group
Constant	5.80 (18.02)***	5.18 (16.87)***	5.25 (31.07)***	4.97 (28.71)***	3.67 (3.30)**	4.60 (10.78)***	5.18 (15.81)***	4.57 (14.59)***
R-Squared	0.87	0.90	0.88	0.90	0.89	0.90	0.88	0.90
Number of observations	98	98	98	98	82	82	98	98
F-Statistic	78.97***	100.84***	89.98***	112.61***	77.59***	101.00***	85.77***	109.53***
P-value for Sargan's misspecification test							0.18	0.20

Notes: [1] Robust standard errors, adjusted for heteroscedasticity, are used; [2] T-statistics are reported in brackets; [3] *** denotes statistical significance at the 1 percent level, ** at the 5 percent level, * at the 10 percent level using two-tailed tests.
Source: Authors' estimations.

The coefficient on the dummy variable for Sub-Saharan Africa (SSA) represents the impact on health outcome of unobservable SSA-specific factors with respect to the reference group (North Africa). In both the under-five and infant mortality rates, the dummy variable for the SSA is strongly negative – and strongly positive for North Africa. In other words, if all the explanatory variables of the model had exactly the same levels in all the countries, under-five and infant mortality rates be some 59 to 64 percent and 35 to 40 percent higher, respectively, in SSA countries. There would be equal corresponding fall in North African countries.

Other results are equally interesting. For example, ethnolinguistic fractionalization has a significant positive effect on both under-five and infant mortality rates in Africa, a result that conforms with the findings of Filmer and Pritchett (1997). Female literacy matters for under-five and infant mortality rates in Africa. Female literacy is robustly and negatively correlated with both health outcomes. These results are consistent with those of Filmer and Pritchett (1997); Zakir and Wunnava (1997); and Baldacci et al. (2004). In addition, one needs to be cognizant of cross-sector synergies as female literacy is a significant determinant of child and infant mortality and, hence, must be included in any analysis of policy options that could help precipitate declines in child mortality. Urbanization has only significantly weak negative association with under-five and infant mortality rates (when per capita total health expenditure is used) in the ROLS cases but insignificantly negative in other cases (unlike Amouzou and Hill, 2006).

Indeed, Gupta et al. (1999) finds insignificant negative urbanization effects for infant mortality while Baldacci et al. (2004) find mixed insignificant urbanization effect for under-five mortality. On the other hand, Filmer and Pritchett (1997) find insignificant positive urbanization effect for under-five mortality. The weak effect of urbanization could be due to the rapid increase of urban poverty in such a way that urban poor are losing their health advantages compared to rural residents (see APHRC, 2002). Per capita income has generally weak effect on mortality rates, consistent with those of Ricci and Zachariadis (2006) but in contrast to Amouzou and Hill (2006). This type of result has been explained by Cutler et al. (2006) by the negative effects of population growth on income per head. As has been argued by Acemoglu and Johnson (2006), improvements in health technology and the associated reduction in child mortality reduce GDP per capita, at least temporarily, if health innovations result in large increases in population – which appears to be the case in most African countries. However, it is unlike the significant negative effects findings of Baldacci et al. (2004), Zakir and Wunnava (1997), and Pritchett and Summers (1996). Mosgrove (1996) finds no indication that, given per capita income, spending a larger share of GDP on health reduced child mortality. Casterline *et al.* (1989), using Egyptian data, found only weak and insignificant effects of income on infant and child mortality. In India, Das Gupta (1990) finds that per capita income is not significantly associated with child mortality. The general weak effect of capita income may well be indicating the fact that very poor countries are being less affected than relatively rich countries. However, the number of physicians significantly matters for the reduction of both under-five mortality and infant mortality in Africa. Indeed, Robst and Graham (1997), and Robst (2001) have found that more physicians reduce mortality rates mainly in rural areas, while the effect is small in urban areas. Grubaugh and Santerre (1994) also find that there is a positive impact on health – as

measured by infant mortality rates – of certain health inputs, such as the number of doctors and hospital beds.

However, given data limitations, we could not include an important variable which is critical to the determination of health outcomes in Africa – human immunodeficiency virus (HIV) prevalence. As would be discussed in the concluding part of this paper, there is both non-reporting and under-reporting on HIV/AIDS cases and other diseases in many African countries. Available statistics indicate that though the prevalence of HIV in the developing world has begun to level off - but deaths from AIDS are still increasing in sub-Saharan Africa. By the end of 2006, 39.5 million people across the world were living with HIV, many in sub-Saharan Africa (see Figure 12). To capture the effect of HIV prevalence we demonstrate with the results from a shorter data (N=36 compared with N=98 in the basic estimations) size as shown in Table 5. The results show that the coefficients on HIV rate is positive (and statistically significant at the 1 percent level for under-five mortality and at 5 percent level for infant mortality), suggesting that a greater prevalence of HIV is associated with higher child and infant mortality in Africa. This is worse in the case of child mortality.

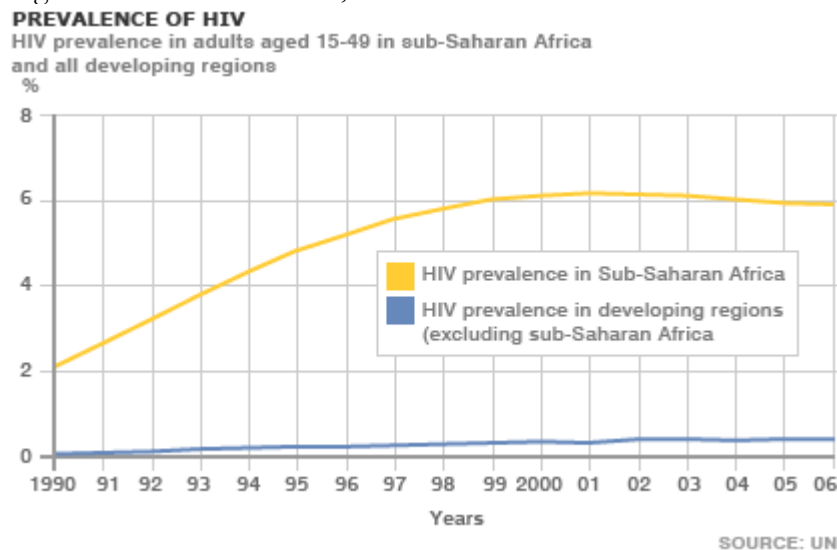Figure 12: HIV Prevalence, 1990 - 2006

Table 5: **Regression Results for Under-Five and Infant Mortality Rates, Showing the Effects of HIV Prevalence in Africa (**Robust OLS [1, 2, 3])

Variable	Under-Five Mortality Rate		Infant Mortality Rate	
	(1)	(2)	(3)	(4)
Per Capita Total Health Expenditure	-0.26 (-3.50)**		-0.27 (-4.33)***	
Public Per Capita Health Expenditure		-0.21 (-3.26)**		-0.20 (-3.61)***
Ethnic Fractionalization	0.07 (1.43)	0.07 (1.12)	0.08 (1.80)*	0.97 (1.43)
Female Literacy	-0.26 (-2.89)**	-0.21 (-2.54)**	-0.23 (-3.05)**	-0.18 (-2.56)**
Urban Population	-0.05 (-0.53)	-0.06 (-0.59)	-0.04 (-0.54)	-0.04 (-0.52)
GDP Per Capita	0.087 (0.79)	0.09 (0.80)	0.13 (1.31)	0.10 (0.97)
Physicians	-0.09 (-1.10)	-0.13 (-1.88)*	-0.10 (-1.49)	-0.15 (-2.32)**
HIV Prevalence	**0.18 (6.00)***	**0.16 (4.76)***	**0.08 (3.07)**	**0.06 (2.10)**
Constant	5.97 (13.31)***	5.61 (10.86)***	5.25 (13.32)***	5.00 (10.83)***
R-Squared	0.91	0.91	0.88	0.89
Number of observations	36	36	36	36
F-Statistic	42.25***	34.63***	26.78***	38.05***

Notes: [1]Robust standard errors, adjusted for heteroscedasticity, are used; [2]T-statistics are reported in brackets; [3] *** denotes statistical significance at the 1 percent level, ** at the 5 percent level, * at the 10 percent level using two-tailed tests.
Source: Authors' estimations.

V. CONCLUSIONS AND POLICY IMPLICATIONS

Though greater expenditure on health outcomes is being advocated by many, little empirical evidence exists on the beneficial impact of such expenditure on infant and child mortality. Using a panel data for African countries, this paper provides support for the proposition that total and government expenditure on health matter for these health outcomes.

The results therefore show that the indicator selected to monitor MDG-4 goal has close, consistent relationship to levels of total and government expenditure across Africa. Indeed, the model presented and estimated in this paper improves upon previous studies at the macro level in terms of including a richer palette of explanatory variables within an estimation strategy that explicitly takes into account unobservable counties-specific factors. Thus, a number of policy interventions could be effective in moving African countries toward the goal. Therefore, the results support the view that health expenditure can be more effective in African countries in achieving the MDGs. Thus, increases in expenditure suggested by the magnitude of the estimated coefficients would be greatly helpful in moving African countries toward the MDG target for health, although not necessarily sufficient to achieve it in all regions.

One needs to be careful, though, in terms of interpreting the empirical evidence. Focusing on aggregate and public health expenditure as determinants of under-five and infant

mortality, however, may not bring out some essential compositional effects. For instance, for the same level of public health expenditure, higher allocations to primary health care as opposed to secondary and tertiary health care (the latter primarily benefiting urban elites) do appear to be effective in improving child health outcomes, especially when implemented in good governance settings (see Gupta et al., 1999; Filmer et al., 2000). A related point is that aggregate health expenditure will be a poor proxy for measuring the effect of health resources on health outcomes if it is spent ineffectively to begin with. Physical input, human resources, access, and process indicators such as number of doctors or hospitals per capita and immunization rates have been found to be significant and robust determinants, capturing the importance of effectively targeted health expenditure on health outcomes such as child and infant mortality (Hanmer et al., 2003, Anand and Barnighausen, 2004). These are precisely the same indicators that have been identified as representing health system delivery constraints to scaling up of health interventions (Ranson et al., 2003). This underscores the need for more and better information on both the cost-effectiveness and general effectiveness of health interventions, the latter taking into account broader health system factors that may make it difficult to realize health gains on the ground. Without this background to inform policy choices, increases in health expenditure will likely not translate to better health outcomes (see Tandon, 2005). A similar point is made by Savdeoff (2004).

Relative to the significant cost of raising expenditure, the strong effects of health expenditure on health outcomes also confirm the important role of reforms aimed at improving the efficiency and targeting of health outlays. If budgetary allocations for health are to boost economic growth and promote the well-being of children and infants (especially of the poor), policymakers in African countries need to pay attention to absolute expenditures within the health sector. Those absolute expenditures – both their size and efficiency – are an important vehicle for promoting equity and furthering second-generation reforms. The finding that the both total and government health expenditure are paramount in determining health outcomes also has major implications for international assistance policy for African countries. This is an opportunity for the international community, especially the G-8 countries to fulfill their promise of scaling up aid to African countries in accordance to the agreements of Monterrey of 2002 and Gleneagles of 2005, all of which had been re-affirmed in subsequent similar fora.

In addition, it remains essential for the international community to meet its promises to double official development assistance to Africa and to make such aid effective and predictable in the context of both the Monterrey Consensus and the Paris Declaration on Aid Effectiveness. While several African countries have benefited from debt relief especially in the framework of the Highly Indebted Poor Countries initiatives it must also be acknowledged that aid to Africa actually fell in 2005 and 2006, if debt relief is taken out of the equation. On aid, the priority is to meet the long-standing commitment by developed countries to contribute 0.7 percent of Gross National Income (GNI) to Official Development Aid, (ODA) alongside a big improvement in the quality of aid. This should include untying and simplifying aid procedures and putting an end to policy "conditionalities". This is necessary since, for Africa, the attainment of the MDGs is a minimum prerequisite for poverty reduction and sustainable development. They provide the foundation for meeting the much higher hopes and ambitions of the African continent. But with development partners' assistance this would be near impossible.

It is also known that going to scale on many of the interventions will require the mobilization of additional resources and that it will take a combination of enhanced and improved domestic resource mobilization and increased ODA for this to be possible. The private sector also has a role to play in achieving the MDGs by paying their taxes regularly and on time and increasing the provision of education and essential health services.

However, African countries unable to match decreases in mortality with increases in resources will be faced with difficult choices over the adjustment of the health services provided. With increased demand for health services and declining mortality, drawing on new client groups, and a wider range of choices concerning what, when, how and where to learn, and with added demographic pressure, existing financing mechanisms may not be adequate. In particular, government resources alone may not suffice to pay both for the expansion of health systems and for improvements in health quality. These governments would need to forge new partnerships with the providers and beneficiaries of health services in order to mobilize the necessary resources, to encourage efficiency and to introduce flexibility in order to permit everyone to pursue the pathways and health service access opportunities which best meet their needs. For example, non-public institutions, such as private businesses, can provide resources to health institutions either through partnership arrangements or through more general support for the health system.

This paper also finds that female literacy, ethnic fractionalization, and the number of physicians matter for health outcomes in Africa. We also find that HIV prevalence very significantly leads to higher child and infant mortality in Africa. Thus, health expenditure alone will not be enough to attain the child mortality MDG target by 2015. This underscores the importance of the health system and other non-expenditure factors to facilitate the attainment of this MDG outcome. Thus, other policy implications include improving human capital (especially female education generally and medical education for the production of more physicians), checking the brain drain of African trained medical physicians, and accelerating measures to prevent HIV infections through massive education/enlightenment, capacity building as well as use of low-cost anti-retroviral therapy for treatment. The example of Kenya under the Academic Model for Prevention and Treatment of HIV/AIDS (AMPATH) should be mini-model for other African countries. The AMPATH which started in 1990 as a purely medical-school-to-medical-school collaboration between the Indiana University School of Medicine (later Moi University School of Medicine) has resulted in the treatment of more than 50,000 (about half of whom are already receiving anti-retroviral therapy) through its hub at the Moi Teaching and Referral Hospital in Eldoret and 18 rural clinics predominantly radiating out towards the Ugandan border and Lake Victoria in western Kenya. This effort is commendable, given, as noted earlier, the HIV/AIDS pandemic continues to devastate Africa. With just over 10 percent of the world's population, sub-Saharan Africa accounts for almost two-thirds (24.7 million) of the global population living with HIV and the continent's estimated 2.1 million AIDS deaths in 2006 comprised 72 percent of total worldwide AIDS deaths.

There is also the need for African countries to consolidate and sustain the wave of democracy sweeping the continent while making efforts to resolve existing conflicts in the continent. This is particularly important given the strong positive effects of ethnolinguistic fractionalization, a war/conflict breeder, on health outcomes. Indeed, strengthening

democracy can have a strong payoff for health outcomes and hence no less important than increasing spending.

The results of this paper also point to a greater role for multilateral development banks like the African Development Bank (AfDB). Apart from increased use of sector-wide approaches (SWAPs), other instruments of intervention in regional member countries (RMCs) include: budget support for resource transfer to the national budget, on the basis of long-term, trusting, partnerships; policy dialogue in poverty reduction strategy and assistance strategy fora about the priority due to pro-poor social sector programs in public expenditure allocations, with due recognition of the needs of evolving programs of action; sector-level dialogue on sector strategies and their implementation, and on the coherence of allocations and actions with strategic options and agreed objectives; and capacity building support at both national and sector levels for performance assessment and performance management.

The need to monitor and report progress on the MDGs has created a large constituency for statistics in Africa and in the international community as it has led to an unprecedented increase in demand for better statistics from a wide range of sources to support the development effort, to design appropriate policies and programs, and to monitor and evaluate their effects and impacts. Undoubtedly, good information is vital to making intelligent choices about strategies and investments in health. Yet in much of Africa, information that would be critical to policy-makers, health systems managers and public consumers of health services is often not available, despite increasing emphasis on data collection in many countries. Indeed, lack of timely, accurate information about expenditure on health, health indicators and their determinants represents a key constraint for good policymaking and effective use of limited resources in developing countries, particularly in Africa. ECA (2007) had summarized the data challenge in Africa as follows: "poor quality statistics, weak statistical capacity and institutions – exacerbated by poor funding – and lack of harmonization of statistical standards". In the absence of a baseline value, it is difficult to assess the feasibility of a target. In some countries, data have been collected intermittently on some indicators, so there are no data series to assist in determining trends or measuring progress over time. Also in many countries, education and health data are incomplete as basic education data cover only public schools, basic health data do not cover private clinics and there is under-reporting on HIV/AIDS cases and other diseases (AU, ECA, and AfDB, 2007).

Although important advances have been made in improving the quality of data and policy-relevance of data on national spending and external flows from public and private donors (thanks to the African Development Bank's and its partners' statistical capacity building through the ICP-Africa), the need to further improve data systems is clear. Lack of timely, accurate and relevant statistics is as a major constraint to effective monitoring of progress towards the MDGs and for policy design. Many African countries do not have sufficient and timely data on which assessment of progress can be based. As a result, policy and decision-making have suffered, proper allocation and targeting of resources and programs has been hampered, and generally, governments have not been held to account for their decisions and their citizens remain the poorer because of it. None of the existing tracking systems or efforts provides up-to-date, comprehensive information in a form that addresses central policy questions. Without information about what resources are expected -- from whom, and for what purpose -- and without better tracking of how those funds have been spent, policy

leaders, advocates and analysts are unlikely to be able to effectively raise additional resources and allocate them toward the populations and types of services that are vital to the achievement of the Millennium Development Goals. This calls for a coordinated way to coherent and long-term support to improve government budgetary and financial systems in Africa; to institutionalizing standard approaches to documenting and analyzing health sector expenditures; and to providing more timely, predictable and forward-looking data on the health sector indicators and related measures. African countries need to give priority attention to the problem of inadequate statistics. Accurate and timely availability of relevant data is critical for MDG-based planning, monitoring and evaluation, and reporting. In this regard, within the context of the region's efforts to improve statistics through the African Charter on Statistics, it may be necessary to consider the feasibility of creating an African statistics-clearing house.

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APPENDIX

List of Countries Included in the Sample used in the Estimations

The countries included in the estimations are Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Democratic Republic of Congo, Republic of Congo, Côte d'Ivoire, Djibouti, Egypt, Eritrea, Ethiopia, The Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.