Macroeconomics and Health: The Way Forward in the WHO African Region

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Abstract

The specific objectives of this paper were: (i) to estimate the effects of life expectancy and mortality rates on the per capita gross national income; and (ii) to propose to countries in the African region a set of generic steps for implementing the action agenda recommended by WHO Commission for Macroeconomics and Health (CMH), within the context of national development plans and poverty reduction strategies. Four simple double-log (log-linear or constant elasticity) regression equations were estimated with data from the World Health Statistics 2011. The dependent variable in all equations was the logarithm of per capita gross national income.

The key findings were as follows: in equation 1 the coefficients for life expectancy and adult literacy had a positive sign and were statistically significant at 95% confidence level; in equation 2 the coefficient for under 5 mortality rate took a negative sign and was statistically significant; in equation 3 the coefficients for adult mortality rate and adult literacy were statistically significant and had expected signs; and in equation 4 the coefficient for maternal mortality was not statistically significant at 95% level of confidence but had a negative sign as expected. These results clearly show a significant correlation between per capita gross national income and life expectancy, under 5 mortality rate, and adult mortality rate. This implies that by working closely with health development partners, countries in the African region can better their economic prospects through greater investments in close-to-client health systems and increased use of proven cost-effective prevention and treatment interventions to curb mortality and increase life expectancy.

Keywords: Macroeconomics, Health, African Region, Way Forward

1. Introduction

Improved health is not just an end in itself but also an essential means of reducing poverty and achieving sustained economic growth. In the WHO African Region, health outcomes must be significantly improved because the current huge burden of disease largely undermines socioeconomic development.

In recognition of the above, the WHO Director-General established the Commission on Macroeconomics and Health (CMH) in January 2000 to study the links between increased investments in health, economic development and poverty reduction. The findings of the Commission, published in December 2001 (WHO 2001), demonstrated that judicious investments in health can help increase economic growth in developing countries.

The Commission's analysis revealed that:
- ill-health contributes significantly to poverty and low economic growth;
- a few health conditions account for the high proportion of ill-health and premature deaths;
- a substantial increase in the use of cost-effective interventions in addressing priority health problems can potentially save millions of lives per year;

- a close-to-client (CTC) system is required to increase cost-effective interventions targeting the poor;
- the current level of health spending in Member States is not sufficient to help implement cost-effective interventions.

The Fifty-fifth World Health Assembly, held in May 2002, commended the CMH action agenda as a useful approach to the achievement of the Millennium Development Goals (MDGs) (WHO 2002, UN 2000) and the targets of the New Partnership for Africa's Development (NEPAD) (NEPAD 2001).

The purpose of this paper is to put the key CMH findings in the WHO African Region perspective. The specific objectives are: (i) to estimate the effects of life expectancy and mortality rates on the per capita gross national income (GNI); and (ii) to propose to countries in the African region a set of generic steps for implementing the action agenda recommended by WHO Commission for Macroeconomics and Health (CMH), within the context of national development plans and poverty reduction strategies.

2. Methods

2.1 Analytical framework

According to the CMH, per capita gross national income is hypothesized to be a function of health outcomes (e.g. life expectancy and mortality rates) and education (e.g. adult literacy) (WHO 2001). We would expect a positive relationship between per capita GNI and life expectancy and educational attainment. As life expectancy and adult literacy increase, we would expect per capita GNI to also increase (and vice versa). On the contrary, we would expect an inverse relationship between per capita GNI and mortality rates. This is because while increases in life expectancy and adult literacy enhance stocks of human capital, and hence productive capabilities, premature mortality erodes them.

Formally, the effect of life expectancy and mortality rates on the per capita GNI can be expressed as follows:

$$PER\_CAPITA\_GNI = f\left(LE, U5MR, 1560MR, MMR, Literacy\right)..........(1)$$

where: f = function of; PER_CAPITA_GNI = per capita GNI in purchasing power parity, i.e. total gross national income divided by population; LE = average life expectancy at birth (years); U5MR = under-five mortality rate (probability of dying by age 5 per 1000 live births); 1560MR = adult mortality rate (probability of dying between 15 and 60 years per 1000 population); MMR = maternal mortality ratio (per 100 000 live births); Literacy = adult literacy rate (%).

We estimated four simple double-log equations specified below:

$$\log PER\_CAPITA\_GNI = \log \alpha + \beta_1 \log LE + \beta_2 \log Literacy + \varepsilon..........(2)$$

$$\log PER\_CAPITA\_GNI = \log \alpha + \beta_1 \log U5MR + \beta_2 \log Literacy + \varepsilon...................(3)$$

$$\log PER\_CAPITA\_GNI = \log \alpha + \beta_1 \log 1560MR + \beta_2 \log Literacy + \varepsilon.............(4)$$

$$\log PER\_CAPITA\_GNI = \log \alpha + \beta_1 \log MMR + \beta_2 \log Literacy + \varepsilon.............(5)$$

where: log is the natural log (i.e., log to the base e, where is e equals 2.718); a is the intercept term; $\beta's$

are the coefficients of elasticity (CoE), i.e. the percentage change in per capita GNI for a given small percentage change in a specific explanatory variable; and ε is a random (stochastic) error term capturing all factors that affect per capita GNI but are not taken into account explicitly (Gujarati 1988, Kirigia *et al* 2004).

CoE is the ratio of the percentage change in per capita GNI (PER_CAPITA_GNI) to the percentage change in a specific independent (explanatory) variable, such as LE. Mathematically, the absolute value of the CoE ranges from zero (perfectly inelastic PER_CAPITA_GNI) to infinity (perfectly elastic PER_CAPITA_GNI). Unitary elastic PER_CAPITA_GNI depicts a scenario in which the percentage change in PER_CAPITA_GNI is exactly equal to the percentage change in an independent variable, i.e. CoE=1. Inelastic PER_CAPITA_GNI refers to a situation where PER_CAPITA_GNI is relatively unresponsive to a change in an independent variable, i.e. CoE > 0 < 1. Similarly, elastic PER_CAPITA_GNI implies that GNI is relatively responsive to a change in an independent variable, i.e. CoE > 1. Thus, in simple terms, elasticity is a measure of the degree of responsiveness of a dependent variable (PER_CAPITA_GNI in our case) to changes in an independent variable, such as LE.

2.2 Data Sources and Analysis

The per capita GNI, average life expectancy, under-five mortality rate, adult mortality rate, maternal mortality rate, and adult literacy rate data on the 46 countries in the WHO African Region, which was used to estimate equations 2 to 5, were obtained from the World Health Statistics 2011 (WHO 2011). The raw data were collated in EXCEL spreadsheet, and subsequently, exported to STATA (Statacorp 2010) for analysis. Prior to estimation of the regression equation 2 to 5, both the dependent and independent (explanatory) variables were transformed into their logarithms using standard STATA commands.

3. Results and Discussion

3.1 Analysis

Table 1 provides a summary of descriptive Statistics (mean, median, standard deviation, minimum, maximum). There is remarkable variation in per capita GNI between countries, e.g. the minimum is Int\$163 while the maximum is Int\$19,330 (in PPP). Also there is significant variation in the life expectancies and mortality rates between countries – minimum is 47 years and maximum is 73 years.

Table 2 presents the results of regression of logarithm of per capita GNI against various health outcomes (explanatory variables). In equation 1, the coefficients for the logarithms of average life expectancy at birth and adult literacy were positive and statistically significant at 95% level of confidence. The per capita GNI was elastic with respect to both explanatory variables since their coefficients were greater than one. As shown in Table 2, the life expectancy elasticity coefficient is 2.732, implying that for a one percent increase in the life expectancy, the per capita gross national income on the average increases by about 2.732 percent. The adjusted R-squared was 0.268, meaning that the two independent variables explained about 27% of the total variations in the per capita GNI.

In equation 2, the coefficient for under-five mortality rate was statistically significant and had as expected a negative sign. The coefficient for adult literacy rate had as expected a positive sign but was not significant at 95% confidence level. Both coefficients were less than one, signifying that in this equation, the per capita GNI was inelastic in relation to under-five mortality and adult literacy. The adjusted R-squared was 0.298, implying that under-five mortality rate and adult literacy rate accounted for about 30% of variations in per capita GNI.

In equation 3, the coefficients for adult mortality rate and adult literacy were both statistically significant at 95% level of confidence. The coefficient for adult mortality had a negative sign and that of adult literacy

rate was positive as expected. Whilst the coefficient for adult mortality was less than one, the one for adult literacy was greater than one. The adult mortality rate elasticity coefficient was -0.793, denoting that for a one percent increase in adult mortality rate, the per capita gross national income on average decreases by about 0.793%. Since the adult mortality rate elasticity value of 0.793 is less than one in absolute terms, one can say that the per capita GNI is adult mortality rate-inelastic. On the contrary, since the adult education rate elasticity value of 1.383 is greater than one in absolute terms, we can say that per capita GNI is adult literacy-elastic. The adjusted R-squared was 0.257, indicating the two variables explained almost 26% of variations in the dependent variable.

In equation 4, the coefficient for maternal mortality ratio was not statistically significant at 95% confidence. However, it had a negative sign as expected. The maternal mortality elasticity coefficient of -0.062 indicate that for a one percent increase in MMR, the per capita GNI on average decreases by about 0.062%. Because the MMR elasticity value of 0.062 is less than one in absolute terms, one can conclude that the per capita GNI is maternal mortality-inelastic. On the other hand, the coefficient for adult literacy rate was statistically significant and had a positive sign, and was greater than one meaning that per capita GNI is adult literacy-elastic in equation 4. In view of the fact that the adult literacy elasticity coefficient is 1.20, the per capita GNI on average increases by about 1.2% for a one percent increase in the adult literacy rate. The adjusted R-squared was 0.213, which suggests that the two variables accounted for 21% of variations in the per capita GNI.

Figures 1 and 5 show that as the life expectancy and adult literacy rate increase, the per capita GNI also increases. Figure 2 and 3 and 4 portray that per capita GNI decreases with increase in under-five mortality rate, adult mortality rate, and maternal mortality ratio. These results clearly show that there is a strong correlation between capita GNI and life expectancy, under-five mortality rate and adult mortality rate. The findings are consistent with those of the CMH (WHO 2001), Gallup and Sachs (2001) and Bloom and Sachs (1998) among others.

The WHO African Region population suffers a heavy burden of communicable and non-communicable diseases. In the year 2002, 66% of the 10.7 million deaths that occurred in the Region resulted from the ten causes shown in Figure 7 (WHO 2005a). HIV/AIDS, lower respiratory tract infection, malaria, diarrhoeal diseases and maternal and perinatal conditions alone accounted for 55% of the deaths and 54% of disability-adjusted life years. This heavy burden of disease and its multiple effects on productivity, demography and education have contributed significantly to Africa's chronically poor economic performance (Bloom and Sachs 1998).

Substantial increase in the use of available cost-effective interventions to address priority health problems can potentially save millions of lives each year in the Region. About 47% of the population in the Region have no access to health services and more than 70% of the people have no access to essential drugs (WHO 2000); and about 59% of pregnant women deliver babies without the assistance of skilled health personnel; out-of-pocket expenditures constitute 51% to 90% of the private health expenditure in 14 countries and 91% to 100% in 24 countries (in a region where 38.2% of people live below the international income poverty lines of US$1 per day) (WHO 2005a). Many cost-effective interventions (e.g. use of insecticide-treated materials, directly-observed treatment - short-course (DOTS), condoms, vaccines against childhood killer diseases) are available and yet they are not reaching the poor (WHO 2001). There is, therefore, need to substantially increase the use of such interventions.

A close-to-client (CTC) system (a health system that provides affordable promotive, preventive and basic curative care in localities inhabited mainly by the poor) is required to scale up cost-effective public health interventions targeting the poor (WHO 2001). CTC systems consisting of health centres, health posts and outreach points are capable of delivering the key cost-effective interventions (cost-effective interventions are public health interventions with the least cost per unit of effectiveness) required to reduce the burden of disease and improve health conditions in the Region. Developing an effective CTC system requires increased investments in infrastructure and health personnel capacity building.

Opportunities exist to improve current resource allocation within health systems by increasing the proportion of resources allocated to CTC systems. By undertaking significant health sector reforms, more resources can be reallocated from over-resourced, less cost-effective systems of care to more cost-effective CTC systems. There is also growing evidence in the Region that national health systems (Kirigia *et al* 2007), hospitals (Mbeeli *et al* 2004; Osei *et al* 2005; Kirigia, Emrouznejad and Sambo 2002; Masiye *et al* 2002; Zere, McIntyre and Addison 2001; Kirigia, Lambo and Sambo 2000) and health centers (Kirigia *et al* 2008; Masiye *et al* 2006; Renner *et al* 2005; Kirigia *et al* 2004; Kirigia, Sambo and Scheel 2001) can attend to more patients if the resources available to them are better managed.

Despite efforts to improve efficiency in the use of available resources, the level of health spending in Member States is not sufficient to scale up cost-effective interventions. The CMH estimated that a minimum of US$ 34 per capita per year would be required to provide an essential package of public health interventions (WHO 2001). Between 2000 and 2008 the number of countries achieving the CMH recommendation increased from 11 to 27, out of 46 African Regional countries (WHO 2011). Thus, the 19 (41%) countries currently spending less than US$ 34 on health per capita per year will need to increase their budgetary allocations to reach the recommended minimum health spending.

Member States can increase their domestic resource allocations to health. Heads of State of African countries made a commitment in Abuja to allocate at least 15% of their annual budgets to the health sector (OAU 2000). Yet, in 2008, six countries spent less than 5% of their total annual national budget on health; 14 countries spent between 5% and 9%; 18 countries spent between 10% and 14%; and seven countries spent 15% and above of their budget on health. Only seven countries spent 15% or above of their budgets on health (WHO 2011). This means that 39 countries spent less than 15% of their national budgets on health and will need to take appropriate steps to fulfill the commitment given by their respective Heads of State (See Figure 8).

In spite of the increased allocation of domestic resources to health, a financing gap will still need to be filled from external sources. CMH estimated that, globally, US$ 27 billion per year (as measured against the current US$ 6 billion) will need to be mobilized from international donors to complement domestic resources (WHO 2001). Therefore, Member States need to advocate, individually and collectively, at the international level, for a fair share of such funds. In addition, there will be need to significantly improve the management of resources and the capacity to use the additional resources in a manner that especially benefits the poor.

Investment in health-related sectors ought to be increased to tackle social determinants of health (WHO 2008). Almost 66% of the population in the Region lack sustainable access to improved sanitation facilities; 39% lack sustainable access to an improved water source; and 37% of adults in the Region are illiterate (WHO 2011). This underscores the need for increased investments in sectors such as water, sanitation, education and agriculture, all of which have an impact on health in order to achieve the relevant MDGs.

3.2 Regional Response to the Report of the Commission on Macroeconomics and Health

In June 2002, a Regional Health Economics Capacity Strengthening Workshop took place in Windhoek, Namibia. A total of 103 senior economists, planners and public health specialists from 43 countries participated in the workshop which critically examined the CMH findings and recommendations; the health component of Poverty Reduction Strategy Papers (PRSPs); health care financing; national health accounts; and health systems performance assessment.

The participants generally felt that the CMH report presented compelling evidence that health was a prerequisite for economic development, and that the recommended action agenda was pertinent for the African Region. However, they envisaged that countries planning to implement that agenda might face the following challenges:
   a)   limited capacity of ministries of health to undertake advocacy and negotiate with other sectors and

      partners;
   b) weak national health management information systems;
   c) need to revise the health component of PRSPs to include strategies for scaling up the essential package of interventions;
   d) proliferation of committees at the national level;
   e) attrition of human resources resulting from brain drain;
   f) lack of sustainable health care financing mechanisms;
   g) making health systems responsive to the needs and expectations of the poor;
   h) coordination of donor support to enhance contributions to the attainment of national health developmental goals.

At the recommendation of the Windhoek workshop, an agenda item entitled "Macroeconomics and health: The way forward in the African Region", was included in the Fifty-third session of the WHO Regional Committee for Africa. The Committee adopted a resolution (WHO Regional Office for Africa 2003) urging Member States of the African Region:
   a) to widely disseminate among all stakeholders the findings and recommendations of the CMH and build consensus for action;
   b) to establish or strengthen institutional mechanisms for implementing the recommendations of the CMH;
   c) to develop multi-year strategic plans for scaling up health investment into pro-poor health interventions;
   d) to revise health sector and health-related development plans, the relevant components of Poverty Reduction Strategy Papers (PRSPs) and Medium-Term Expenditure Frameworks (MTEFs) to incorporate strategic plans for scaling up pro-poor health investments;
   e) to fulfill the pledge made by Heads of State in Abuja to allocate at least 15% of their annual budgets to the improvement of the health sector;
   f) to utilize the multi-year strategic plans to mobilize resources from domestic and external sources in a sustainable manner;
   g) to closely involve relevant ministries and agencies with responsibility for specific components of the strategic plan (e.g. health services, water, sanitation, nutrition, education, finance, planning) during planning, implementation and monitoring;
   h) to strengthen health economics and public health capacity within the ministries of health and other relevant sectors in order to enhance health investments, and pre-empt and mitigate negative effects of development projects on public health.

3.3 The Way Forward

The CMH report recommends enhanced political commitment, at both national and international levels, to increased investments for scaling up the delivery of essential health interventions using close-to-client health systems (WHO 2001). Given that different Member States face different challenges, and considering the lessons learnt from the Ghana (Government of Ghana 2005) experience, this paper suggests steps that can be taken to implement the CMH recommendations. The steps suggested below should be implemented within the framework of:
   a) existing national policies, development plans and poverty reduction strategies;
   b) administrative, planning, implementation and monitoring structures and processes existing in individual countries.

The suggested steps to be taken at the country level are as follows:

Step 1:   Dissemination, at country level, of the findings and recommendations of the Commission on Macroeconomics and Health and consensus building on their relevance

Ministries of health, with support from relevant United Nations (UN) Agencies and the World Bank, may

organize a meeting of key stakeholders to disseminate the CMH findings and recommendations and build consensus on their relevance to the national health situation. This would potentially set in motion a process that would build greater political and financial commitment to the health sector.

Step 2:   Making institutional arrangements to facilitate implementation of the recommendations of the Commission on Macroeconomics and Health in the countries

Individual countries may set up an inter-ministerial national steering committee on macroeconomics and health or, where appropriate, expand the terms of reference and composition of existing committees performing similar functions to take action on the CMH recommendations. This committee may spearhead the scaling up of priority health and health-related interventions and, at national and international levels, undertake advocacy for increased investments in health. Its membership may consist of ministers responsible for health, economic planning and regional cooperation, finance, local government and rural development, works and housing as well as parliamentarians, representatives of civil society, the private sector, UN agencies, and bilateral and multilateral donors.

A technical committee, acting as the secretariat of the national steering committee on macroeconomics and health, may be established to undertake a health situation analysis and an economic analysis of alternative health interventions and financing options. This committee may comprise a health economist, representatives of ministries of health (including public health specialists and planners); education; water supply and sanitation; finance; economic planning and regional cooperation; local government and rural development; as well as representatives of the donor community and relevant UN Agencies.

Step 3:   Analysis and strategy development

Drawing on the recommendations of CMH and national strategic plans such as the Poverty Reduction Strategy Papers, the technical committee will carry out analyses of: the national health situation; national health policies, including human resource policies and plans; health system performance (goals and functions); national health accounts (or national health expenditure) to quantify the financial contribution to health from the activities undertaken by all the sectors; and macroeconomic (including poverty) indicators to facilitate the development of a sound strategy for scaling up health interventions. The emerging gaps in information and health systems performance can be addressed in a multi-year strategic plan. The main purpose of this plan is to extend the coverage of essential health and health-related services after taking into account synergy with other health-related sectors. It should ensure consistency with sound macroeconomic policy framework and provide the basis for filling information gaps through adequate investment in operations research.

The plan would contain:
    (a) an analysis of health and health-related sectors;
    (b) a set of priority national health problems;
    (c) a package of cost-effective essential public health interventions for addressing problems;
    (d) current levels of coverage of various essential interventions;
    (e) the target coverage of individual essential health interventions;
    (f) the cost of scaling up the use of essential interventions to the desired levels including the cost of strengthening close-to-client health services;
    (g) an estimate of the current level of spending (broken down by source) on essential interventions;
    (h) an estimate of the expenditure gap (i.e. item "f" minus item "g" above);
    (i) an indication of how the expenditure gap would be financed (from domestic and international sources);
    (j) a monitoring and evaluation section.

The relevant ministries and agencies primarily responsible for specific components of the defined essential public health interventions will need to devise proposals for scaling up such interventions.

Step 4:   Filling expenditure gaps

The technical committee will, on the recommendation of the national steering committee, develop scenarios of how expenditure gaps can be bridged. The advantages and disadvantages of each scenario should be carefully examined and considered. The scenarios may include: reduction of the technical and allocative inefficiencies within and between health-related sectors and subsectors; termination of least cost-effective diagnostic procedures and health interventions; national social health insurance (Carrin, Desmet and Basaza 2001; WHO 2005b; African Union 2006) funded from "sin" taxes (e.g. on tobacco and alcohol); a dedicated tax for health; reallocation of budgetary resources from other sectors such as defence; reduction of subsidies for the export-oriented manufacturing industry; funds expected from the highly-indebted poor countries (HIPC) initiative; soft loans and grants from multilateral and bilateral donor agencies; development of project proposals for submission to the Global Alliance for Vaccines and Immunizations (GAVI), the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) and the Multicountry AIDS Programme of the World Bank.

Step 5:   Using the multi-year strategic plan (step 3) to revise the health and health-related sector development plans and the relevant components of PRSPs

The multi-year strategic plan should be incorporated into the relevant health and health-related sector development plans (e.g. health, water supply and sanitation, education) and the relevant components of poverty reduction strategy papers (PRSPs) and the Medium Term Expenditure Frameworks (MTEF).

Step 6:   Implementation of the multi-year strategic plan

The ministries and agencies with primary responsibility for specific components of the strategic plan (e.g. health services, water, sanitation, nutrition) will scale up their respective interventions.

Step 7:   Monitoring, evaluation and reporting

The national steering committee on macroeconomics and health will monitor the implementation of the strategic plan as well as the proposals developed by each lead ministry or agency. To that end, the national steering committee will develop key indicators and decide on a frequency of reporting consistent with the national reporting mechanisms. As a guide, the national steering committee may consider meeting half-yearly to review progress in the implementation of the strategic plan and its relevant proposals. The lessons emerging from these reviews will then be used to revise the plans.

Partner alliances ought to be built and maintained at all levels, to ensure that countries receive appropriate support when developing, implementing, monitoring and evaluating multi-year plans for scaling up pro-poor health investments. Such alliances would involve stakeholders such as the relevant UN and bilateral development agencies, the World Bank, the African Development Bank, the African Union, the NEPAD Secretariat, civil society, international and national NGOs, private organizations, academics and global initiatives, e.g. GFATM, GAVI, Stop TB, Roll Back Malaria Partnership.

Those partners ought to:
(a) disseminate the key CMH findings and recommendations to governments, members of parliament, civil servants, civil society, local leaders and other relevant development partners;
(b) support countries to develop or strengthen existing national institutional mechanisms for planning, implementing and monitoring the CMH recommendations;
(c) provide technical support to the national steering committee and lead ministries or agencies to enable them to develop plans and proposals for scaling up relevant national interventions;
(d) strengthen Member States' capacity to collect, analyze, document, disseminate and utilize relevant health and economic evidence;
(e) monitor and document lessons emerging from the implementation of the CMH recommendations

in different countries and facilitate shared learning among countries.

5. Conclusion

This paper has attempted to put the key findings of the CMH within the context of the African Region. It has proposed to countries in the African Region a set of generic steps for implementing the action agenda recommended by CMH, within the context of national development plans and poverty reduction strategies.

By working closely with health development partners, countries can better their economic prospects through greater investments in close-to-client health systems and increased use of cost-effective interventions in addressing priority national health problems.

Acknowledgement

This paper contains the views of the author only and does **not** represent the decisions or stated policies of the World Health Organization.

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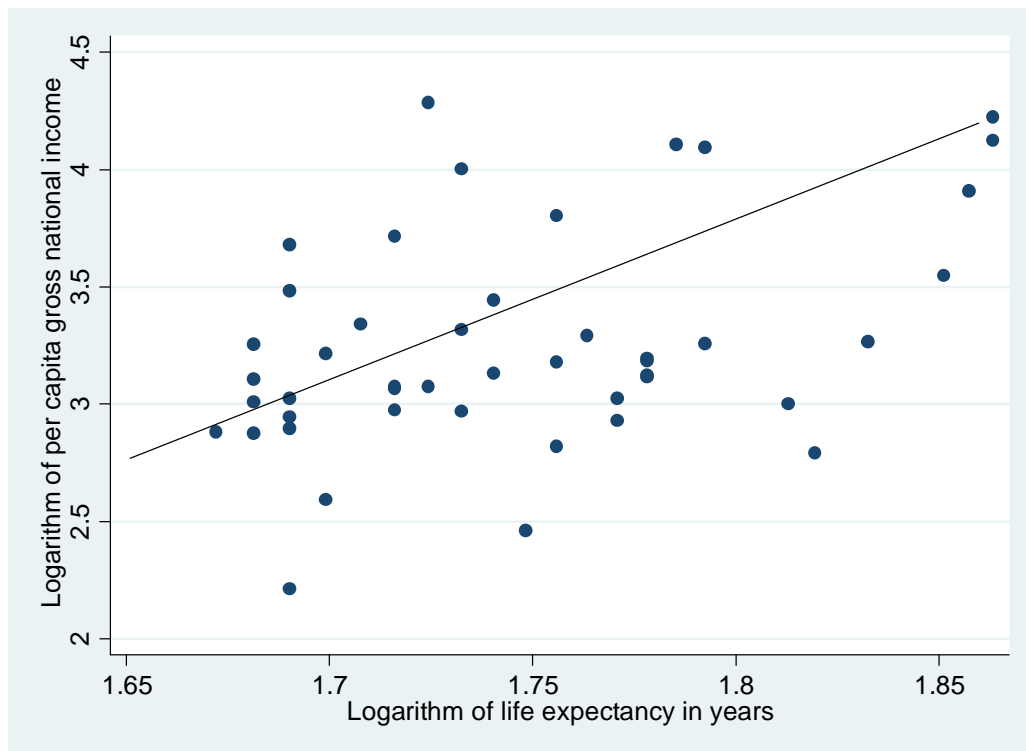
Figure 1: Per capita gross national income versus life expectancy for males
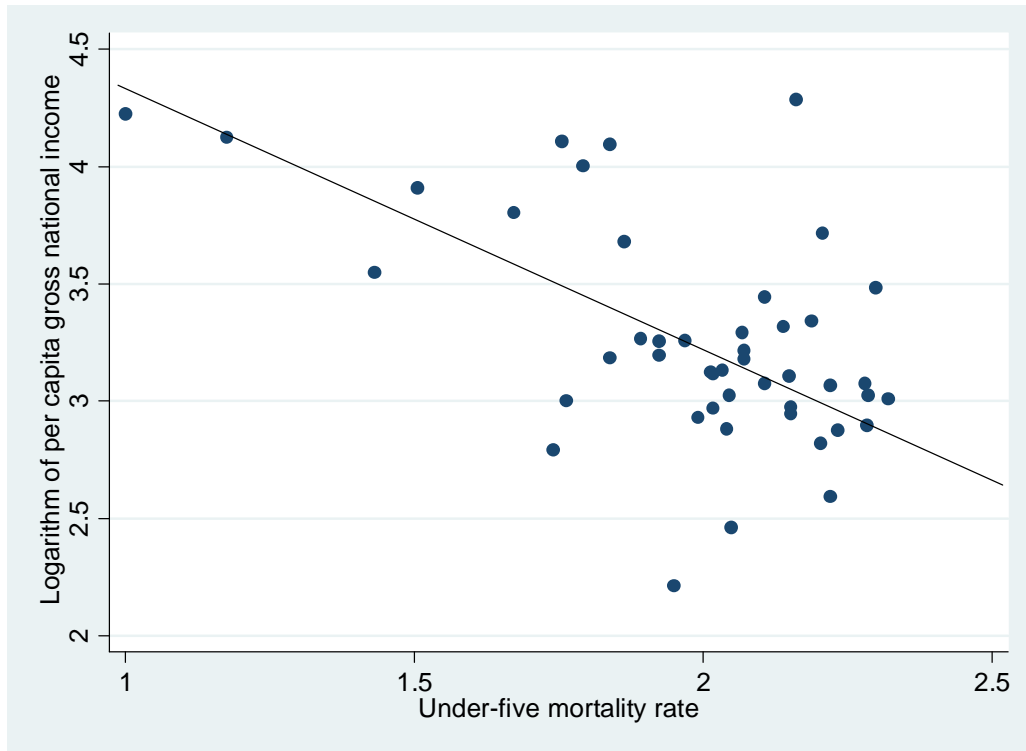
Figure 2: Per capita gross national income versus under-five mortality rate
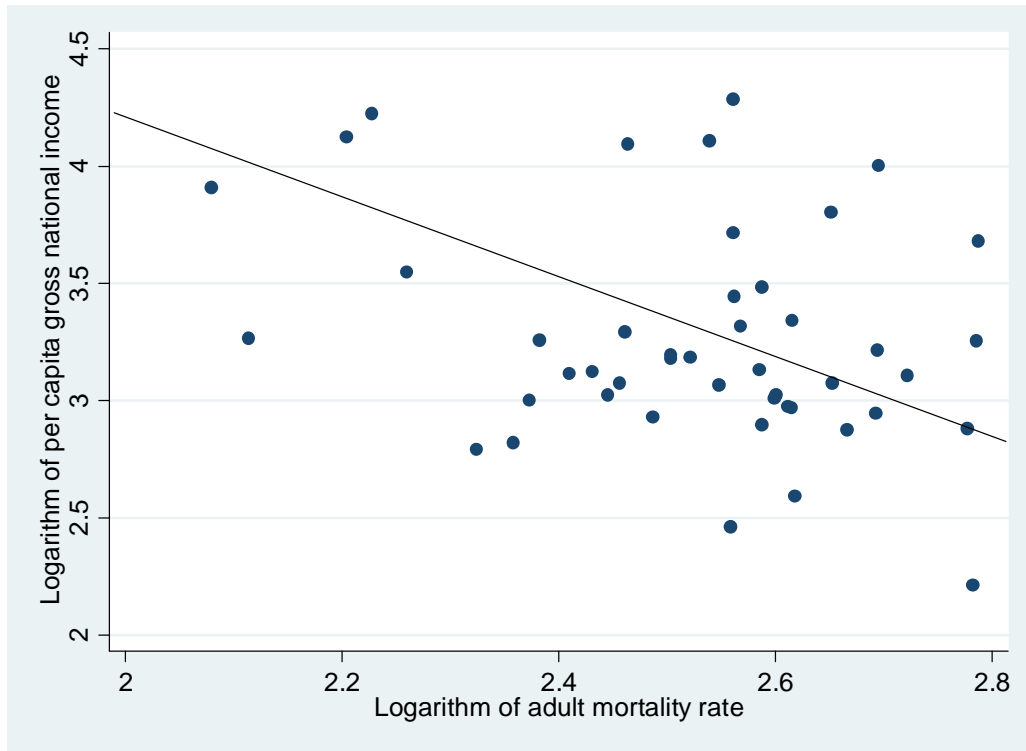
Figure 3: Per capita income versus adult mortality rate
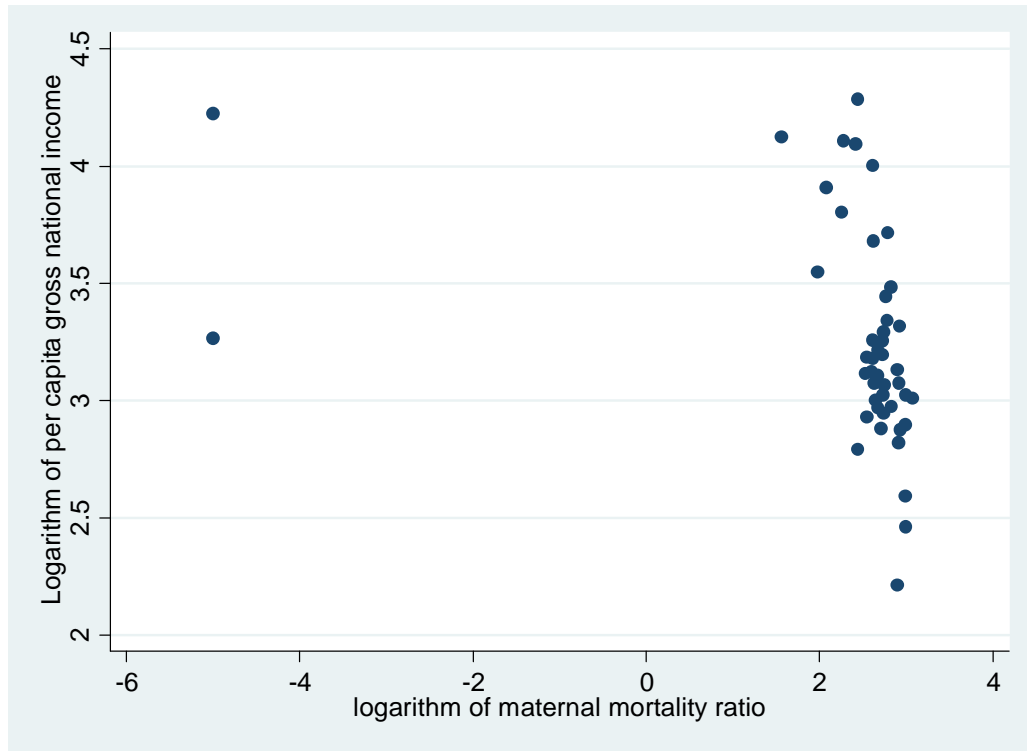
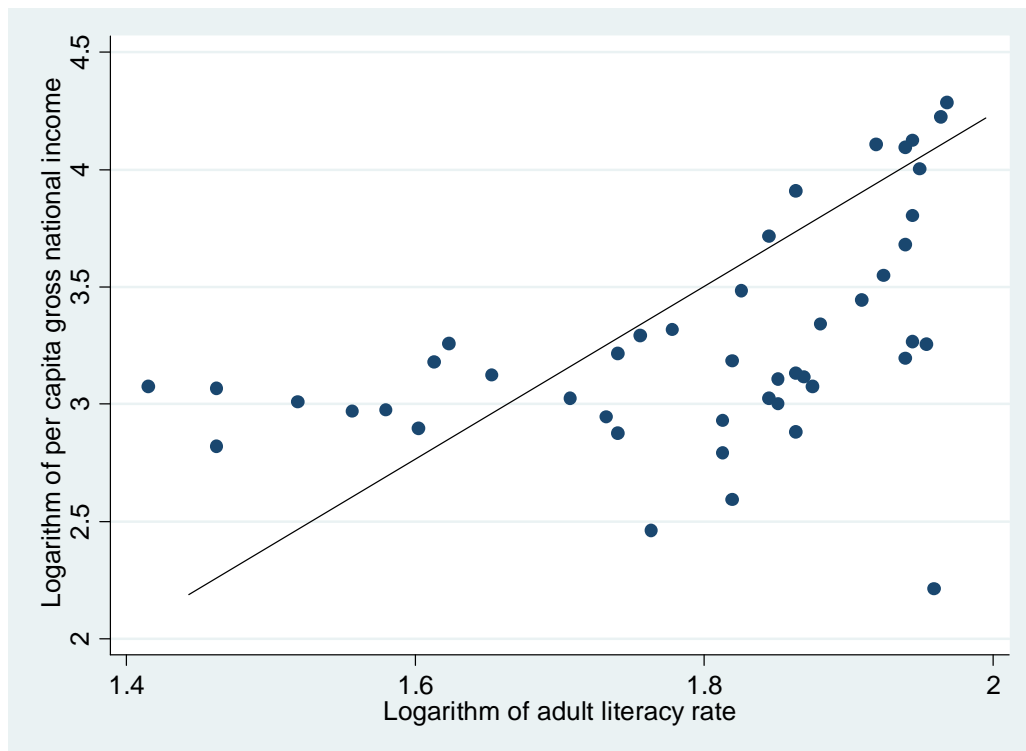Figure 4: Per capita income versus maternal mortality ratio
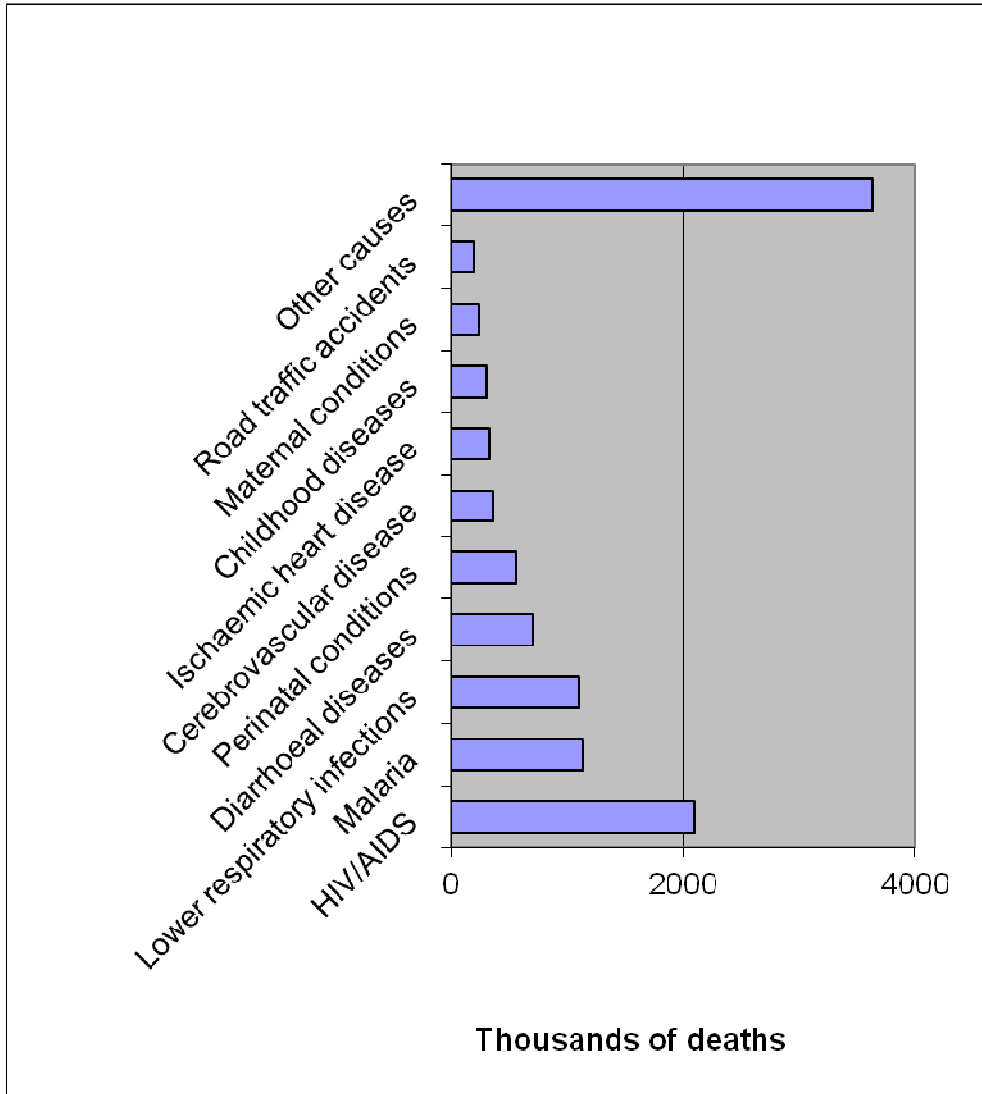
Figure 5: Per capita income versus adult literacy rate

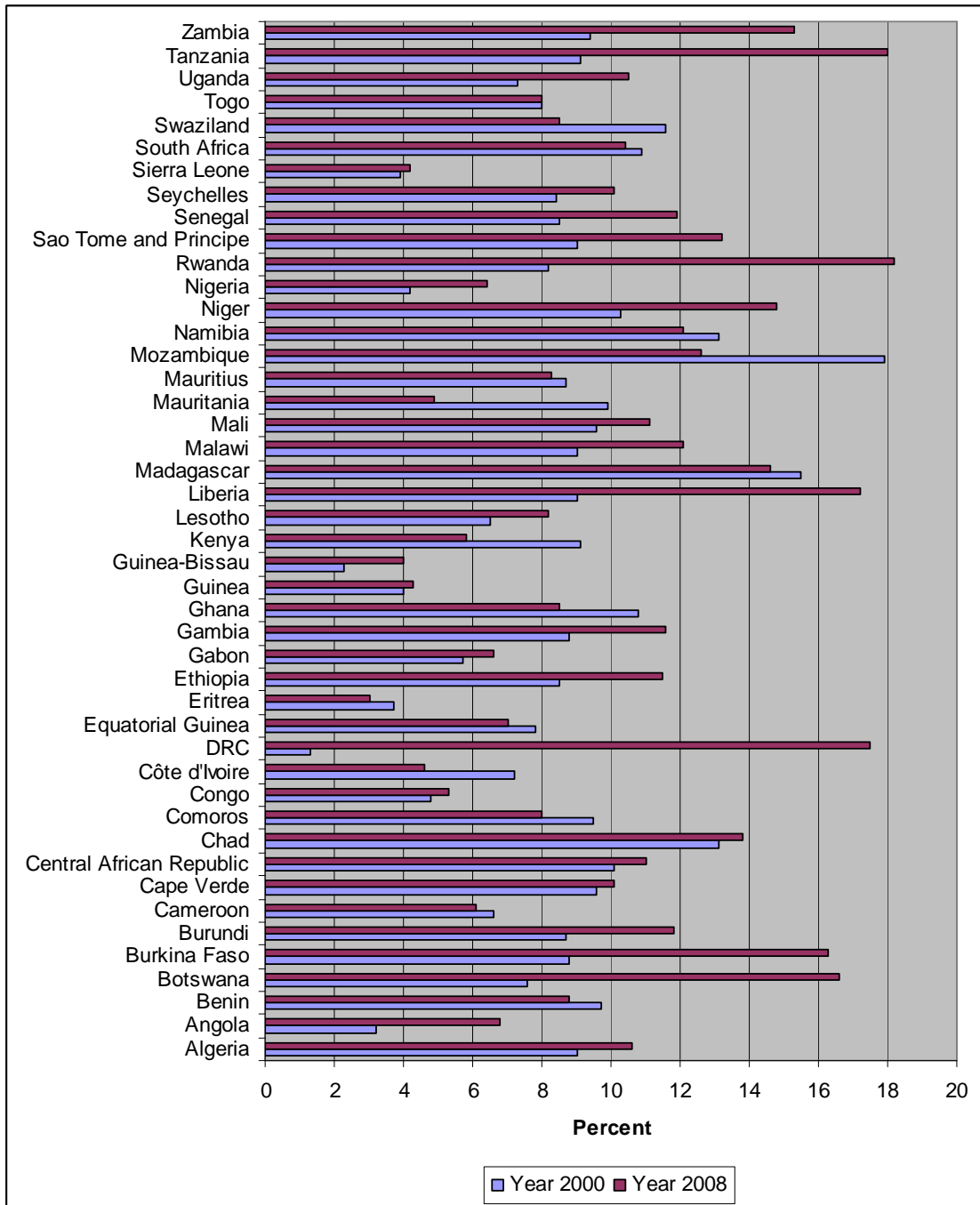Figure 6: Leading causes of death in the WHO African Region, 2002

Figure 7: General government expenditure on health as % of total government expenditure

Table 1: Descriptive Statistics (mean, median, standard deviation, minimum, maximum)

Variable	Mean	Median	Standard deviation	Minimum	Maximum
Per capita gross national income	2,632	1,510	4,640	163	19,330
life expectancy	54	55	7	47	73
Under-five mortality rate	127	111	51	10	209
Adult (15-60 years) mortality rate	383	364	125	120	613
Maternal mortality ratio	620	490	284	36	1,200
Logarithm of adult literacy rate	63	70	20	26	93

Table 2: Regression of logarithm of per capita gross national income against various health outcome indicators

Equation	Variable	Coefficient	't' statistic	P > |t|	95% confidence interval	
1	Logarithm of life expectancy at birth	2.732117	2.40	0.021	.4331116	5.031122
	Logarithm of adult literacy rate	1.136843	2.80	0.008	.3183335	1.955352
	Constant	-3.551565	-1.84	0.073	-7.444182	.3410521
	Number of observations	46				
	F(2, 43)	9.24				
	Adjusted R-squared	0.2680				
2	Logarithm of under-five mortality rate	-.6861078	-2.80	0.008	-1.180436	-.1917794
	Logarithm of adult literacy rate	.7308112	1.62	0.112	-.178284	1.639906
	Constant	3.308904	2.89	0.006	1.001472	5.61633
	Number of observations	46				
	F(2, 43)	10.56				
	Adjusted R-squared	0.2981				
3	Logarithm of adult (15-60 years) mortality rate	-.7934807	-2.24	0.030	-1.507957	-.0790047
	Logarithm of adult literacy rate	1.38352	3.51	0.001	.5885413	2.178499
	Constant	2.782053	2.42	0.020	.4617483	5.102358
	Number of observations	46				
	F(2, 43)	8.78				
	Adjusted R-squared	0.2569				
4	Logarithm of maternal mortality ratio	-.0618062	-1.53	0.132	-.1430848	.0194724
	Logarithm of adult literacy rate	1.201144	2.83	0.007	.3440617 2.058226	
	Constant	1.248408	1.56	0.125	-.3620744	2.8588
	Number of observations	46				
	F(2, 43)	7.10				
	Adjusted R-squared	0.2133				