

# A New Health Classification Framework<sup>+</sup>

## Final Report



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## Table of Contents

<b>1. Executive Summary</b>	<b>3</b>
<b>2. Chapter 1: Introduction</b>	<b>5</b>
<b>3. Chapter 2: Methodology-theoretical framework</b>	<b>7</b>
<b>4. Chapter 3: DALY as a measure of health inequality across countries</b>	<b>16</b>
<b>5. Chapter 4: Results for Overall inequality and Poverty adjustments</b>	<b>19</b>
<b>6. Chapter 5: Results for Health Inequality and Health Poverty measures</b>	<b>30</b>
<b>7. Chapter 6: The World Health Index</b>	<b>36</b>
<b>8. Chapter 7: Country experiences at Subnational Level: India &amp; Nigeria</b>	<b>46</b>
<b>9. Chapter 8: Some Country experiences regarding funding: Uganda and Swaziland</b>	<b>51</b>
<b>10. Chapter 9: Conclusions</b>	<b>55</b>
<b>11. Chapter 11: Recommendations</b>	<b>56</b>
<b>12. References</b>	<b>57</b>
<b>13. Annex</b>	<b>61</b>

## Executive Summary

Gross National Income (GNI) per capita, has been universally used as a measure of a country's income status and its ability to meet its health funding needs, and in determining which countries can graduate. GNI is simple and is calculated in every country and hence easily available. However, focusing on the health classification of countries and access to health, merely using GNI per capita to measure economic progress and a country's ability to meet its funding obligations for health programmes is not sufficient. Any measure that seeks to replace it should be based on some principles of simplicity, replicability, representativity, universality and it should be grounded in theory.

A new measure has to be simple to understand, replicable and easy to compute, representative of the issues it is meant to capture, make use of universally acceptable inputs, and also be grounded in theoretical principles of socio-economic wellbeing. The approach seeks a more nuanced measure of incomes and ability to pay for health, as measured by, Gross National Income (GNI) per capita. In this regard the approach will take into account, i) countries' ability to domestically finance health as measured by GNI per capita; and ii) countries' health system capacity and efficiency in delivering health services and interventions.

The approach posits that income inequality, especially if it reflects the income share of the very poor in a country, is a good indicator of health access. In low-income countries, inequality is also strongly linked to spatial inequality between rural and urban areas, with the poor living mainly in rural areas. Therefore, inequality measures also reflect the spatial divide between rural areas, which typically have low health access levels, and urban areas with a higher level of health access. Unequal infrastructure investment also explains this spatial-inequality, which feeds into overall national inequality, and inequitable health access. Thus, inequality measures, have both an income as well as a spatial dimension embedded in them.

The approach shows that income inequality is correlated with "health inequality" across countries, and within countries and groups. The Disability-adjusted Life Years (DALY) captures not only disease burden but also 'health inequality' across countries.

The approach thus proposes an adjusted GNI per capita as a measure of health access and health quality considerations. Countries around the world are then ranked using the new approach using a 'continuous scale', as opposed to a categorical scale. In addition to this, the group derives a World Health Index that tracks progress on various health indicators across the world and time, and the two are complimentary. The WHI also allows for flexibility in incorporating suitable and appropriate indicators for any of the health partners, and to also cater for vulnerable groups and key populations. The WHI can also capture the strength and evolution of the entire health systems.

Empirically, we will present the level of GNI per capita, calculate the adjusted-GNI per capita measure, and the above-mentioned World Health Index (WHI), which consists of an index of multiple health related indicators. We provide an assessment of the quality of the data. We show the re-classification of countries based on the GNI adjusted measure and the WHI. For adjustments, we use a linear approach consistent with the Atkinson index approach. We calculate these new measures for all countries in the world where data exists. For the WHI, we include variables that capture health systems quality, health systems capacity (both human and infrastructure) and health systems efficiency.

The re-classification of countries is illustrated in greater detail by using a sub-national case study of India and Nigeria, which have high rates of poverty and disease burden. In the reclassification of countries, for example, (1) Uganda, that does not change much due to relatively strong health access and health quality, (2) Gabon and Botswana, and South Africa, for example, that drop down in rankings due to the high 'health

poverty gap' and high health inequality', (3) Rwanda and Madagascar and Nepal, re-rate upwards, due to a lower poverty gap, lower health inequality and outcomes, and better health systems. The experiences of these countries are contrasted in terms of (1) their health performance, (2) their donor relations, and (3) their re-classification and how a more optimal healthcare system would look like.

This approach also contributes to the literature on inequality-adjusted (or distributionally-sensitive) and poverty-adjusted measures of GNI/GDP per capita, by adding the DALY-adjusted GNI per capita, and makes allusions to discussions on issues such as "inclusive growth" and "shared prosperity".

## Chapter 1: Introduction

The pursuit of the Sustainable Development Goals (SDGs) over the next 15 years, and, poverty-reduction strategies, will keep the focus on the world in dealing more directly with some of the most challenging health issues, especially in low income countries. The donor community and the recipient countries have partnered in the quest to meet the development targets. With African countries growing at an average rate of 5% of GDP in the last 15 years, and discovering natural resources, this has meant that they keep getting closer to graduating into middle-income status. However, a closer look shows that the growth is not inclusive and their health systems are far from effective. The Ebola outbreak in the last 2 years in some parts of Africa, which rapidly became a global challenge, is a stark reminder of the weak health systems in some of the low-income countries. It is clear that merely making use of Gross National Income per capita, to measure economic progress and a country's ability to meet its funding obligations for health, is not sufficient. There is a real risk of graduating countries prematurely, and they would lose much needed financial resources, as donors withdraw.

This proposal presents a new framework that will not only take into account a country's income level and resource potential, but also incorporate access to healthcare and the quality of the healthcare system.

The framework we propose draws from the principles of 'inclusive growth'. As discussed in Ncube (2015), Inclusive Growth (IG) is economic growth that results in a wider access to sustainable socio-economic opportunities for a broader number of people, regions or countries, while protecting the vulnerable, all being done in an environment of fairness, equal justice and political plurality. Inclusive growth focuses on the rate and pattern of growth, which must be addressed together because they are interlinked. Long-term sustainable economic growth rates are necessary to reduce poverty and must be accompanied by growing productive employment to reduce inequality.

In particular, focusing on the health classification of countries and access to health, merely using GNI per capita to measure economic progress and a country's ability to meet its funding obligations for health programmes is not sufficient. We hence derive theoretically a single scalar that combines (1) GNI per capita, (2) health access, and (3) health systems quality. In addition to this, we derive a world health index that tracks progress on various health indicators across the world and time, and we compare the two.

Empirically, we present the level of GNI per capita, calculate the adjusted -GNI measure, and what we call the World Health Index (WHI), which consists of an index of multiple health related indicators. We provide an assessment of the quality of the data. We show the re-ranking of countries based on our GNI adjusted measure and the WHI. We illustrate the re-ranking of countries by highlighting: (1) Uganda, that does not re-rank much due to relatively strong health access and health quality, and (2) Swaziland, Botswana, and Gabon that drop down significantly. We contrast the experiences of these countries in terms of (1) their health performance, (2) their donor relations, and (3) their re-ranking and how a more optimal healthcare system would look like. We also show how our methodology can be used at a subnational level in India.

Our approach also contributes to the literature on inequality-adjusted (or distributionally-sensitive) measures of GNI/GDP per capita. We make allusion to discussions in international organisations, in particular, “inclusive growth” and “shared prosperity” as advocated by the OECD, World Bank and African Development Bank. This would be one way, tailored to healthcare, to measure such a concept.

Existing global indices of quality of health systems and health inequality (see literature review) and existing broader indices of wellbeing, such as the Social Progress Index and HDI are quite broad and ‘not-fit-for-purpose’, as far as narrow health access and health quality are concerned. In particular, ours is more focused and focuses on healthcare only.

Gross National Income (GNI) per capita, has been universally used as a measure of a country’s income status and its ability to meet its health funding needs, and in determining which countries can graduate. GNI is simple and is calculated in every country and hence easily available. Therefore, any measure that seeks to replace it should be based on some principles of simplicity, replicability, representativity, universality and it should be grounded in theory.

A new measure has to be simple to understand, replicable and easy to compute, representative of the issues it is meant to capture, make use of universally acceptable inputs, and also be grounded in theoretical principles of socio-economic well being. Our approach seeks a more nuanced measure of incomes and ability to pay for health, as measured by, Gross National Income (GNI) per capita. In this regard our approach will take into account, i) countries’ ability to domestically finance health as measured by GNI per capita; and ii) countries’ health system capacity and efficiency in delivering health services and interventions.

Our approach posits that health inequality, is a good indicator of health access. In low-income countries, inequality is also strongly linked to spatial inequality between rural and urban areas, with the poor living mainly in rural areas. Therefore, inequality measures also reflect the spatial divide between rural areas, which typically have low health access levels, and urban areas with a higher level of health access. Unequal infrastructure investment also explains this spatial-inequality, which feeds into overall national inequality, and inequitable health access. Thus, inequality measures, have both an income as well as a spatial dimension embedded in them.

Our approach is flexible enough as to be able to contribute to the resource allocation considerations for various members Equitable Access Initiative (EAI). The adjusted GNI per capita is an input into the resource allocation process, in a way that could target health access and health quality considerations, as well as vulnerable groups.

In our analysis we use a measure of health inequality, the DALY, and health poverty gap measure, to adjust GNI per capita.

## Chapter 2: Methodology – theoretical framework

### 2.1 Drawbacks of using GNI per capita

GNI per capita is a universally used measure of a country's income status and its ability to meet its health funding needs. It relates to GDP per capita, arguably the most widely used measure of market produced economic activity worldwide, but it excludes primary incomes payable to non-resident units and includes primary incomes receivable from non-resident units (net factor payments). Through its direct link to GDP per capita, GNI per capita benefits from being based on international standards for its calculation, a precondition for being used as an assessment of the income position of a country (Stiglitz *et al.*, 2009). As GNI per capita corrects GDP by taking into account earned income from abroad or income flowing out of the country, it provides a better picture of the resources available to the country's residents, and hence, the country's ability to domestically finance certain (health) projects (World Bank, 1989). For that reason, the World Bank – as do many other international organisations – uses GNI per capita as its core indicator to determine the lending eligibility of countries by means of income classifications.

However, a large literature also criticized the use of GNI/GDP per capita as a measure of well-being, poverty or development (see e.g., Stiglitz *et al.*, 2009; or Coyle, 2014). As mentioned by Stiglitz *et al.* (2009), “GDP/GNI is a measure of mainly market production (products that are either exchanged through market transactions or produced with inputs purchased on the market), and thus more geared to measure the aggregate supply side of economies than the living standards of its citizens. Although GDP levels are correlated with many indicators of living standards, the correlation is not universal and tends to become weaker when particular sectors of the economy are concerned.” In particular, GNI/GDP per capita indicators have been criticized because they do not take into account inequality, leisure/hours worked, hidden/informal economies, externalities, depreciation and obsolescence. Furthermore, GNI/GDP is a one dimensional indicator and can therefore be seen as too narrow.

As regards health care access and performance, the GNI/GDP indicators are also strongly limited. Health care is at least in part a public good; and for public goods such as health, education, military investments etc., it is very difficult to assess true values. This means it is difficult to compare two countries with very different spending on these goods and assets. Stiglitz *et al.* (2008) provides the following example: “the United States spends more per capita on health-care than many European countries, yet in terms of standard health indicators, outcomes are worse [...] We need to break down the change in health expenditure into a price and an output effect.”. For public good, indicators should be based on output rather than input, but this would require extensive data. In line with this, it is important to note that the quality of health care system is not accounted for in GNI/GDP indicators, nor is inequality of access to health care (and to public goods in general).

In response to these limits, alternative measures of well-being and poverty have been developed recently, such as the Inequality-Adjusted Human Development Index (IHDI) or the Multidimensional Poverty Index (MPI)

#### 2.1.2 On the need for an inclusive growth perspective

In trying to understand the use of the concept of GNI per capita in classifying countries, there is need to understand the nature of the economic growth, which defines the potential for income. The concept of GNI per capita is not a sufficient measure for progress on inclusive growth. There is a need to subdivide the population in such a way that the poor part of the population is sufficiently reflected. Often, targeting the poor, may result in what is termed pro-poor growth and, also shared growth. The population is then divided into 'poor' and 'non-poor' in terms of consumption and income. A key feature of pro-poor or shared growth, then implies that growth need not apply to the whole economy by only to the income of the 'poor' part of the population [see Alkire and Foster (2011), Bourguignon and Chakravarty (2003), Tsui (2002) and Duclos, Sahn, and Younger (2006), Rauniyar and Kanbur (2010), Klasen (2010), Ianchovichina and Lundstrom (2009), Ncube (2015)]. Growth incidence would be on the poorer part of the population, for growth to be considered as pro-poor (see Ravallion and Chen (2003)).

A key difference between inclusive growth and pro-poor growth is that the latter focuses only on a subset of the groups, the poorer ones, while at least some definitions of inclusive growth insist that all subgroups' incomes grow. Inclusive growth is concerned with opportunities for the labor force in the poor and middle-class alike, unlike the pro-poor growth agenda which focuses mainly on the welfare of the poor. To qualify as "broad-based," growth must occur in most or all sectors of the economy. Proponents of this approach note that countries tend to diversify as they grow, at least up to relatively high income levels ((Imbs and Wacziarg (2003)). Well-being, growth in per capita incomes, pro-poor growth, broad-based growth, all take income or consumption to be the measure of well-being. Inclusive growth should include consideration of non-income dimensions of well-being, especially access to infrastructure and basic social services. Rauniyar and Kanbur (2010) argue that this should be considered as "inclusive development," with "inclusive growth" only applying to the income component. For the non-income dimension, we can classify people by education status.

Various definitions of "Inclusive Growth" all express the need for new approaches to address social inequalities especially in the developing world. These include inequalities in income; assets, both financial and human, education and health; economic opportunities and all spheres of life. For example, the African Development Bank defines Inclusive Growth (IG) as "economic growth that results in a wider access to sustainable socio-economic opportunities for a broader number of people, regions or countries, while protecting the vulnerable, all being done in an environment of fairness, equal justice, and political plurality." The last part of that definition seems to favor the development of capabilities that go well beyond economic opportunities or income growth. One dimension of well-being that does receive considerable attention, as well as most others writing about inclusive growth, is access to good quality employment for all, which then bolsters individual capacity to pay. This echoes the writings of the World Bank (Ianchovichina and Lundstrom 2009) and the Asian Development Bank (Klasen 2010). Of course, employment and income/consumption are very closely related, but other characteristics of a job—security, dignity, voice—matter as well.

In some of the literature, there is an argument that opportunities, not outcomes, do matter in considerations of inclusive growth. In some parts of the literature, there is reference to capabilities and, not functions, as being important. However, it is more difficult to measure opportunities/capabilities, and much easier to measure outcomes/functionings. It is easy to observe a person's income and consumption, but much more difficult to measure what they are capable of earning. Some of the literature distinguishes inequality in opportunities and inequality in outcomes in the income dimensions. Ferreira, Gignoux and Aran (2011)



pursue this distinction empirically. Ianchovichina and Lundstrom (2009), Klasen (2010) and Ramos and van de Gaer (2012) argue that a measure of inclusive growth should include both outcomes (especially income) and opportunities (especially regarding employment, but also access to basic social services).

### 2.1.3 Income inequality and access to healthcare

Access to healthcare is widely considered to be a fundamental part of a health system's performance (Kruk & Freedman, 2008). Generating progress in access to healthcare is explicitly stated as part of the Millennium Development Goals, and the new Sustainable Development Goals for developing countries. Generally, it is interpreted as the requirement that healthcare is available on the basis of need rather than the willingness or ability to pay (Van Doorslaer *et al.*, 2006). It refers to the '[...] people's ability to obtain appropriate healthcare services in a timely fashion and without obstacle' (OECD, 2009). This implies that access to healthcare can be divided into three components: availability of care, (actual) utilization, and the timeliness. The first component, availability of services, pertains to the availability of healthcare services accessible to the population. The geographic accessibility or the physical distance between the consumer and the healthcare service and financial accessibility depending on costs and the consumer's resources are part of this (Peters *et al.*, 2008). The second component of access, utilisation, relates to coverage and utilisation rates for specific healthcare services across the income distribution (Blendon *et al.*, 2002; Van Doorslaer *et al.*, 2006; Kruk & Freedman, 2008; OECD, 2009). The third component of access is waiting time, which can be an impediment for access.

In developed countries an extensive system of universal healthcare coverage substantially reduces the link between ability and willingness to pay on the one hand and consumption for a core set of health services (OECD, 2014). In a developing country context, however, the level of individual income is a much stronger determinant of individual health consumption due to higher geographic and financial barriers and less effective utilization across the distribution, leading access to even basic services still to be one of the major hurdles to better health for the population at large (Gwatkin *et al.*, 2004). The geographic distance and travel time to health facilities is negatively related to healthcare consumption (Hjortsberg & Mwikisa, 2002; Hjortsberg, 2003). As infrastructure tends to be of lower quality particularly in rural parts of the country, the poor in remote rural areas suffer from larger travel time and more costly distribution of medical supplies (Peters *et al.*, 2008).

Regarding utilisation, more generally, specific in-kind health spending programmes are less developed in low- and middle income countries (Van Deurzen *et al.*, 2014), but also, richer citizens are found to benefit relatively more of public spending on health in developing countries (Catri-Leal, 2000; Maniken *et al.*, 2000; Gwatkin *et al.*, 2005; Kruk *et al.*, 2008). This transmits to a large discrepancy between the use of healthcare services between the bottom and top quintile within countries (Peters *et al.*, 2008). For that reason policy experts encourage governments of developing countries to implement pro-poor health policies and measure their healthcare system success by analysing the impact on the poor instead of the entire population. This can help in reversing the regressive nature of healthcare delivery in a large part of the developing world (Kruk and Freedman, 2008).

Financial impediments are arguably the largest impediment for access to healthcare in a developing context. A much larger share of total healthcare spending is funded through out-of-pocket spending in low and

lower-middle income countries compared to high income countries (46.5-54.7 compared to 15.3 per cent), whilst total healthcare spending as a percentage of GDP is lower (4.2-5.3 per cent compared to 12.0 per cent). There is empirical evidence that user fees or price increases can decrease health consumption, in particular by the poor (Jacobs & Price, 2004; Burnham *et al.*, 2004; McIntyre *et al.*, 2006).

**Table 1: Funding sources across different country income groups**

World Bank Income Group	Total health expenditure	Government expenditure	Private	External resources	Out-of- pocket
	(% GDP)	(% of total health expenditure)			
Low	5.3	39.0	61.0	24.7	46.5
Lower- middle	4.2	37.1	62.9	2.1	54.7
Upper- middle	6.1	56.2	43.8	0.3	32.1
High income	12.0	60.9	39.0	0.0	15.3
Global	8.7	57.7	42.2	0.5	22.4

#### **2.1.4 Inequality and poverty as measures of access to healthcare**

Aggregating across individuals, the direct link between individual income and access to healthcare translates into a tight relationship between the distribution of income on the one hand, and inequality of access to healthcare on the other (Simms *et al.*, 2007; Kruk *et al.*, 2008; McIntyre *et al.*, 2006). The relationship between income and healthcare inequality has gained widespread attention among scholars (Macinko *et al.*, 2003; Rajan, 2010; Van Deurzen *et al.*, 2014; O'Donnell *et al.*, 2015). The WHO (2008: 120) explicitly states that '[i]n any country, economic inequality – including inequity in public financing – needs to be addressed to make progress towards health equity'. The correlation between the distribution of income and inequality in healthcare access is for instance reflected in the immunization coverage rates among 1-year olds, which are significantly lower in Africa, South-East Asia, and the Eastern Mediterranean (74-78 per cent) than in the Americas, Europe, and the Western Pacific (92-97 - WHO data). Also within developing countries a relationship between the level of inequality and inequality in healthcare utilisation can be found. Victora *et al.* (2005) report high inequities in basic child care interventions within 9 developing countries, depending on the income quintile.

#### **2.1.5 Income inequality, poverty levels and access to health**

As individual income and therefore income inequality and poverty affect access to healthcare within populations, there is evidence that income inequality leads to lower average and more dispersed healthcare outcomes as well (O'Donnell *et al.*, 2015). Macinko *et al.* (2003) report 33 studies that find a significant

association between income inequality and health outcomes, whilst 12 studies do not report a significant association. Wilkinson and Pickett (2006) report that in 155 papers 70 per cent of the analyses imply that income inequality negatively affects population health. Kondo *et al.* (2009) conduct a random effects meta-analysis on the basis of nine multilevel cohort studies and 19 multilevel cross-sectional studies, finding a modest adverse effect of inequality on mortality and self-related health status in developed countries only. But in a developing context the evidence seems to be stronger. Indeed, Pop *et al.* (2013) only report a relationship between income inequality and lower levels of life expectancy in cross-sectional and longitudinal studies for low- and middle-income countries. For 22 Latin American countries between 1960-2007 Biggs *et al.* (2010) find that a GDP increase translates into higher life expectancy, lower TB mortality and infant mortality rates, but only or much more so when inequality or poverty were constant or decreasing.

Following this discussion, we propose to use poverty and income inequality as a proxy for development progress in general, and health inequality and health poverty, in developing countries, in addition to GNI per capita which tells us something about average individual income. Poverty and income inequality are directly related to equity in healthcare access in developing countries given the tight link between individual income and individual access to health. Moreover, it is a broad measure of equity of access of healthcare systems, which is justified since equity in healthcare access and outcomes can also be improved by better access to education, sanitation, or drinking water and food (Kruk and Freedman, 2008). Poverty and income inequality can reduce the political strength of the poor, which matters for equity in health access as it reduces the voice of already disadvantaged groups.

For academic research an important question is the direction of causality given the reciprocal effects of health on individual income and intervening effects through redistribution (Babones, 2008). Indeed, the relationship between poverty and inequality of access is vicious, rather than a one-way causal relationship, since households facing substantial medical expenses can be pushed further into poverty (McIntyre *et al.*, 2006). For our purposes this is not an issue, however, as we simply look for a proxy for access to healthcare rather than making any causal claims. Second, healthcare equity can be improved as well

## 2.2 Criteria for an adjusted GNI measure

Gross National Income (GNI) per capita, has been universally used as a measure of a country's income status and its ability to meet its health funding needs, and in determining which countries can graduate. GNI is simple and is calculated in every country and hence easily available. Therefore, any measure that seeks to replace it should be based on some principles. The principles are:

- Simplicity
- Replicability
- Representativity
- Universality
- Grounded in theory
- Data quality and data availability
- Be tamper-proof

A new measure has to be simple to understand, replicable and easy to compute, representative of the issues it is meant to capture, make use of universally acceptable inputs, and also be grounded in theoretical principles of socio-economic wellbeing. The new measure should be designed such as to avoid - if possible - that countries could strategically influence the performance, for example by underreporting to increase donor funding.

## 2.3 Modifications to GNI per capita

Our approach seeks a more nuanced measure of incomes and ability to pay for health, as measured by, Gross National Income (GNI) per capita. In this regard our approach will take into account:

- (i) Countries' ability to domestically finance health as measured by GNI per capita;
- (ii) Countries' health system capacity and efficiency in delivering health services and interventions.

Our approach posits that income inequality in a country is a good indicator of health access. In low-income countries, inequality is strongly linked to spatial inequality between rural and urban areas. Therefore, inequality measures also reflect the spatial divide between rural areas, which typically have low health access levels, and urban areas with a higher level of health access. Unequal infrastructure investment also explains this spatial-inequality, which feeds into overall national inequality, and inequitable health access. Thus, inequality measures, have both an income as well as a spatial dimension embedded in them.

In deriving the new measure we make use of two approaches namely a linear adjustment approach and then a non-linear adjustment approach. These are discussed below.

Inequality can be accounted for by adjusting GNI per capita with an inequality aversion parameter. This is an approach developed by Ncube, Shimeles, and Younger (2013) and Ncube (2015), which is adapted from the Dalton-Atkinson framework. Following Ncube, et al (2013) and Ncube (2015), the adjustment is made by adapting the Dalton-Atkinson inequality index, which uses the social utility function with constant elasticity of marginal utility  $\varepsilon$  :

$$(1) \quad U(y_i) = \frac{y_i^{1-\varepsilon} - 1}{1-\varepsilon} \quad \varepsilon \neq 1,$$

$$(2) \quad U(y_i) = \log(y_i) \quad \varepsilon = 1,$$

where  $y_i$  is the income of the individual  $i$ , and  $\varepsilon$  is the elasticity of marginal utility also known as inequality aversion parameter. This utility function can be aggregated to have the social welfare function,

$$(3) \quad SWF(y_1, \dots, y_n) = \sum_j U(y_j).$$

The main purpose of this inequality index is to measure the gap between the actual social welfare and the social welfare computed on perfectly equally distributed incomes.

The Dalton index is defined by using  $U(\bar{y})$  which is the social utility for each person in the community in case of perfectly equally distributed incomes, where each person gets the average income, and  $\bar{U}$  which is the average of the individual social utility (see Dalton (1949),

$$(4) \quad D_{\varepsilon} = 1 - \frac{\bar{U}}{U(\bar{y})} = 1 - \frac{\frac{1}{n} \sum_{j=1}^n [y_j^{1-\varepsilon} - 1]}{\bar{y}^{1-\varepsilon} - 1}.$$

Instead of using the social welfare gap, the Atkinson index uses the gap between the level of income which gives equally distributed social welfare, and the actual average income. The Atkinson index is based on the concept of Equally Distributed Equivalent (EDE) income (see Atkinson (1970)). Equally Distributed Equivalent is that level of income that, if obtained by every individual in the income distribution, would enable the society to reach the same level of welfare as actual incomes.

The EDE is approximated by  $U^{-1}(\bar{U})$ , which is the individual income in the case of each person in the community, having the same social utility  $\bar{U}$ :

$$(5) \quad A_{\varepsilon} = 1 - \frac{U^{-1}(\bar{U})}{\bar{y}} = 1 - \left[ \frac{1}{n} \sum_{j=1}^n \left[ \frac{y_j}{\bar{y}} \right]^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}}.$$

Ncube et al (2013) and Ncube (2015), computed inequality aversion using an alternative formula of the Atkinson index for data partitioned into k equal-sized:

$$(6) \quad A_{\varepsilon} = 1 - \left[ \frac{1}{k} \sum_{j=1}^k [k q_j]^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}} \quad \varepsilon \neq 1$$

$$(7) \quad A_{\varepsilon} = 1 - k q_F \quad \varepsilon = 1,$$

where  $q_j$  is the share of aggregate income belonging to the group j, and  $q_F$  is the geometric mean income share. This expression is used to obtain the inequality aversion parameter for a given value of the Atkinson index.

## Linear Adjustment with general inequality and health inequality

Following Atkinson(1970, 1987) and modifications by Alkire and Foster(2010), the GNI per capita can be adjusted linearly using a measure of inequality.

That is, adjusted GNI per capita, is given by

$$(8) \quad \text{Inequality adjusted GNI per capita} = y(1 - A)$$

where y is GNI per capita and A is a measure of inequality.

Alkire and Foster adjust the Human Development index for inequality, in a similar way.

Inequality can be measured by the GINI, or share of income for the bottom 40% of population, or at least in poor countries, can be measured by the headcount level of extreme poverty.

In our approach, seeing that we are targeting inequality in health as a whole, we use a measure of ‘health inequality’, as captured by the Disability-adjusted Life Years(DALYs). Therefore in equation (8) the term A is replaced with **D, the DALY rate lost per capita**. D is a penalty factor on GNI per capita.

The adjustment formulas (8) is simple enough and can applied across countries for comparison.

### Non-linear adjustment

Ncube et al(2013) use the Dalton inequality index formula in order to adjust GNI per capita. The average income is approximated by the GNI per capita, and the average social welfare is approximated by GNI per capita adjusted by inequality aversion parameter. Ncube et al, obtain Dalton inequality aversion approximation given by

$$(9) \quad pc\_GNI\_D_e = \frac{pc\_GNI^e}{\frac{pc\_GNI^{1-e} - 1}{1 - e}}.$$

Formula (9) can also be utilized for adjusting GNI per capita, and is in fact a penalty on income. It can be converted into an index and then used to adjust GNI per capita using formula (8) replacing A with equation 9, where again the adjustment parameter captures health inequality.

### Linear adjustment using a general poverty gap measure

In using poverty gap measures to adjust income per capita we utilize the approach of Atkinson (1987) which suggests the measuring of the cost of poverty and subtracting this

Income per capita. Then it would be would be  $y - P$ , where  $y$  is GNI per capita and

$P$  is the cost of poverty. There is also a strong Rawlsian sense of justice, in focusing on poverty ahead of inequality. Then, the poverty-adjusted income is given by

$$(10) \quad \text{GNI per capita adjusted for poverty} = y(1 - P)$$

where  $Y$  is GNI per capita, and  $P$  is the poverty gapmeasure (in the form of a poverty gap relative to income per capita))

Then,

$$(11) \quad \text{GNI per capita adjusted for poverty} = y[1 - \Sigma((z - yi)/y)]$$

where  $z$  is the poverty line,  $y$  is GNI per capita, and you sum over the  $j$  individuals below the poverty line.

### Linear adjustment using the DALY

In our approach we are really interested in adjusting GNI per capita using a measure of disease burden, the Disability Adjusted Life Years(DALY) lost. That is,

**(12) Inequality adjusted GNI per capita =  $y(1 - DALY)$**

where  $y$  is GNI per capita and DALY is a measure of DALYs lost.

Below we explain the DALY as a measure of disease burden and inequality across countries.

## Chapter 3: DALY as a measure of health inequality across countries, and disease burden

### 3.1 DALY

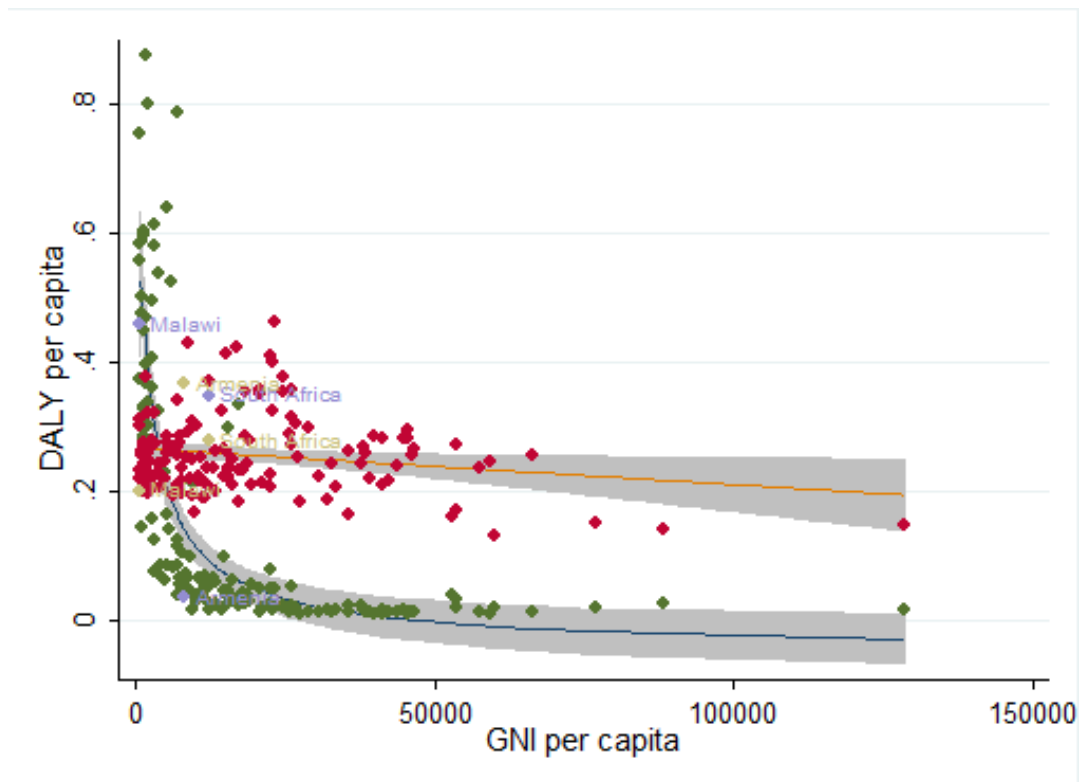
Disability-adjusted life years (DALY) are a health metric to represent the loss of health due to diseases, injuries and risk factors in a population, for instance the population living in a particular region or a country. Refer to figure 2, for a geographic distribution. DALY are a measure of the health gap, i.e., the difference between the health of a population and an ideal profile in which people live a long, disability-free life. The measure was developed by a collaboration led by the World Bank to estimate the Global Burden of Disease (World Bank 1993, Murray 1996). Estimates for 2010 and 2013 are currently available by country, gender, age, disease or injury or risk factors (Murray, Vos et al. 2012; <http://www.healthdata.org/>, Global Burden of Disease Study 2013 Collaborators 2015). Broadly speaking, one DALY is the equivalent of one year lost because of premature mortality or disability.

Operationally, DALY consist of two elements (Murray, Ezzati et al. 2012). First, loss due to premature mortality is captured by the years of life lost (YLL), i.e. the number of deaths (N) multiplied by the residual life expectancy at the age of death, based on local life tables (L). For instance, the death of a man at age 50 in a country where 50-year-old men are expected to live until age 70 corresponds to 20 YLL. Second, loss due to disability is captured by Years Lived with Disability (YLD), i.e. the number of people living with a particular condition (prevalence P) multiplied by the disability weight of that condition (D). Disability weights are measured on an interval scale where 0 corresponds to full health or no disability and 1 corresponds to death (Salomon, Vos et al. 2012).

$$\begin{aligned}(13) \quad & \text{DALY} = \text{YLL} + \text{YLD} \\ & \text{YLL} = \text{N} \times \text{L} \\ & \text{YLD} = \text{P} \times \text{D}\end{aligned}$$

In our analysis we use the **DALY lost per capita attributable to “communicable, maternal, perinatal and nutritional conditions”** to represent the health need of a country. We focus on DALY lost because of these condition can more effectively discriminate countries with problematic healthcare systems. An effective, functioning healthcare system is likely to have lower DALYs from communicable, maternal and nutritional conditions. On the other hand, we do not consider “non-communicable diseases” and “injuries” as these are presents also in well- functioning healthcare systems. Figure 1 shows the correlation between DALY per capita attributable to Communicable, maternal, perinatal and nutritional condition, and GNI per capita. The figure shows that poorer countries have a higher burden of disease from communicable diseases compared to wealthier countries ( $r=0.6$ ). As we expected, there is no significant correlation between the burden of disease from non-communicable conditions and the ability to pay for health.

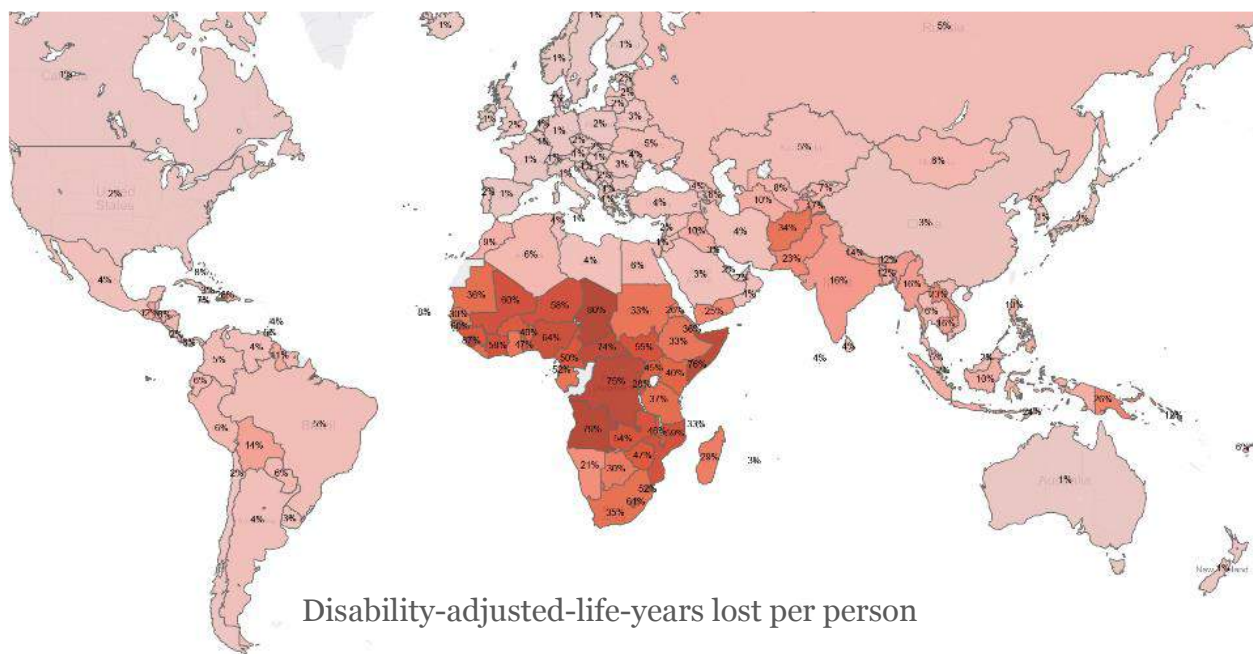




*Figure 1 Correlation between DALY caused by communicable, maternal, perinatal and nutritional conditions and the ability to pay indicator (in log ratio); correlation between DALY caused by non-communicable diseases and the ability to pay indicator.*

The analysis can be adapted by different international organisations wishing to focus on a particular group of disease (e.g. HIV/Aids, Malaria or Tuberculosis), by selecting the DALY component associated with these conditions instead of DALY from Communicable diseases. These data are produced and published by the Institute of Health Metrics and Evaluation (IHME) at the University of Washington (<http://www.healthdata.org/>).

Refer to annex C regarding trends in various health outcomes and disease that go into the calculation of DALYS.



**Figure 2: Disability-adjusted-life-years lost per person.**

## Chapter 4: Results for Overall inequality and Poverty adjustments

### 4.1 Overall Inequality and poverty considerations

Next, we consider the classification of countries as either low income, lower-middle income, upper-middle income and high income on the basis of the latest data. Note that bottom 40 measure of inequality was used and normalized by considering the minimum and maximum and lie between 0 and 1. This inequality measure has a correlation of 79% with the GINI index of inequality. The consideration here is for all of development needs and recognizes that health also and other development needs are interdependent.

In our theoretical framework we made the argument that in a developing context, because of high rates of out-of-pocket spending and low coverage, individual income is an important precondition of the possibility of individual health consumption and hence access to health. This entails that absolute poverty and income inequality, in combination with GNI per capita, which tells us something about average income, is an indicator of equitable health access at the country level (see also Stiglitz *et al.* (2009) from p. 156 onwards, and O'Donnell *et al.* (2015) on comparable issues). Yet inequality and poverty themselves are concepts that require further theoretical specification. For the locus of distribution we use disposable income, which is the closest related to health consumption possibilities of individuals. As our unit we choose the household.

Next, we have to define our inequality and poverty indicators. Our argument pertains to the share of income at the bottom of the distribution, as when this is low, it will prevent a larger share of the population from access to healthcare. We use three indicators for this. First, we use the Gini index, which has the advantage of being the most often used in the inequality literature. This index is generic as it takes the entire distribution into account. It is particularly sensitive to changes around the median of the income distribution. Theoretically, it measures the area between a Lorenz curve, that plots the cumulative percentages of total income against the cumulative number of households, and a diagonal line indicating perfect equality. This indicator varies between 0 and 1, where low values indicate less inequality. Second, we follow the World Bank who promotes 'shared prosperity', defined as growth in average incomes of the bottom 40 per cent of the income distribution (World Bank, 2013; Dollar *et al.*, 2015). The share of income of the bottom 40 per cent varies between 0 and 0.40, where these two asymptotes indicate perfect inequality and perfect equality respectively for the bottom 40 per cent. To make sure that as with the Gini index high values indicate higher levels of inequality, and to define the same range ( $\{0,1\}$ ), we instead define this bottom inequality indicator as:

$$(14) \quad \text{bottom inequality} = 1 - (2.5 * \text{share of bottom 40})$$

Hence, as with the Gini index, now 0 indicates perfect equality (the bottom 40 per cent has an equal share as the top 60 per cent), and 1 indicates perfect inequality (the bottom 40 per cent has no income). This was then normalized to a range of 0 and 1 by considering the minimum and maximum.

As our third argument, we use the absolute levels of poverty provide a more direct picture of equitable access to healthcare within countries. Though it is indeed a more direct picture, absolute levels of poverty measured by the share of individuals below a certain threshold does not take into account the extent to which

individual incomes deviate from this threshold, nor is it in any way sensitive to the distribution of income (just) above the arbitrarily drawn threshold. Because of these disadvantages, we see (absolute) poverty and the (relative) inequality measures as complements. The most often used absolute poverty line is what is called the extreme poverty line, or the percentage of the population living with less than \$1.25 per day. This is again the measure used by the World Bank in its goals for 2030 (World Bank, 2013). As with our Gini index and bottom inequality indicator, lower values imply lower inequality or poverty, and the range is  $\{0,1\}$ .

## 4.2. Inequality and poverty data

For inequality and poverty we rely on the two most often used datasets to look at the evolution of inequality and poverty within countries. We combine the Povcal dataset from the World Bank, which contains information on the absolute poverty headcount (as a percentage of the total population) as well as the poverty gap (in percentages). The absolute poverty line used in this dataset is 1.25 dollar in 2005 constant PPP dollars. We make a number of adjustments, based on the following rules:

- We leave the dataset as large as possible and only drop information in case there are duplicates.
- We drop the two observations for which it is not clear whether the information is based on income or consumption information (Tajikistan)
- Next, we keep for countries for which there is both income and consumption data the data source for which the most recent information is available (consumption data for China, Jamaica, Nicaragua, Romania, Vietnam; income data for Lithuania, Mexico, Peru, Slovenia, and Slovak Republic)
- There are remaining duplicate observations for China, Indonesia, and India. We keep only the information for urban areas. In a later stage we would recommend taking a weighted index based on the population size of the rural and urban information.

Next, we use the World Income Inequality (WIID) dataset from UNU-WIDER, to be exact the WIID 3.ob. From this dataset we obtain information on the Gini index and quintile shares. The WIID dataset contains information for 166 countries for the Gini index from 1995 onwards and a total of 2986 observations or 1319 without duplicates. It has information for 164 countries and 1623 observations or 1115 without duplicates on quintile shares. Again, there are duplicates for which we apply the following rules.

- First, when there is a difference in quality as reported in the dataset, we keep the observation with the highest level of quality
- Second in case there are duplicates of the same level of quality, we just keep the first observation.

Thus, at this stage, for this dataset we mix up income and consumption information. We would recommend in a later stage looking into this in greater detail, to obtain a higher level of within-country consistency.

A discussion of data sources and data quality. For the inequality part, there is a forthcoming special edition from the Journal of Economic Inequality (Also, see for working paper <http://www.econstor.eu/bitstream/10419/103520/1/dp8501.pdf>):

- Incomes at the very top are not captured in household surveys. Wealth is not taken into account. We assume the same CPI across the population. Important for health is that in-kind transfers such as free healthcare are not captured in household surveys.
- In a development context: informality and remittances. Informality is an issue in household surveys, but the same holds for the national accounts data from which GNI per capita is calculated.
- Consumption rather than income is often used to calculate inequality from. Unfortunately in POVCAL and WIID consumption and income cannot always clearly be separated.

Using equation (8) we obtain the results in table 7 for GNI per capita adjusted for inequality as measured by the GINI index.

**Table 2: Classification of Countries using a New Measure of GNI adjusted for the Gini index**

Position	Country	GNI per capita, atlas method	Ranking on the basis of GNI per capita atlas measure	Position	Country	GNI adjusted, in this case for the Gini	Ranking on the basis of GNI adjusted, in this case for the Gini
1	Burundi	260	Low	1	Malawi Central African Republic	137.43	Low
2	Malawi Central African Republic	270	Low	2	Republic	139.84	Low
3	Burundi	320	Low	3	Burundi	173.42	Low
4	Niger	400	Low	4	Democratic Republic of Congo	239.08	Low
5	Liberia	410	Low	5	Liberia	253.38	Low
6	Democratic Republic of Congo	430	Low	6	Niger	262	Low
7	Madagascar	440	Low	7	Gambia	263.5	Low
8	Guinea	460	Low	8	Madagascar	267.08	Low
9	Ethiopia	470	Low	9	Guinea	278.76	Low
10	Gambia	500	Low	10	Ethiopia	295.63	Low
11	Togo	530	Low	11	Comoros	299.88	Low
12	Guinea-Bissau	590	Low	12	Rwanda	321.3	Low
13	Uganda	600	Low	13	Haiti	340.2	Low
14	Mozambique	610	Low	14	Uganda	346.2	Low
15	Rwanda	630	Low	15	Togo	347.68	Low
16	Sierra Leone	660	Low	16	Mozambique	357.46	Low
17	Mali	670	Low	17	Guinea-Bissau	380.55	Low
18	Afghanistan	690	Low	18	Sierra Leone	402.6	Low
19	Nepal	730	Low	19	Mali	448.9	Low
20	Burkina Faso	750	Low	20	Burkina Faso	451.5	Low
21	Benin	790	Low	21	Benin	485.06	Low
22	Haiti	810	Low	22	Nepal	490.56	Low
23	Comoros	840	Low	23	Zimbabwe	496.22	Low
24	Zimbabwe	860	Low	24	Afghanistan	498.18	Low
25	Tanzania	860	Low	25	South Sudan	517.75	Low
26	South Sudan	950	Low	26	Bangladesh	547.42	Low
27	Cambodia	950	Low	27	Tanzania	559	Low
28	Tajikistan	990	Low	28	Cambodia	608	Low
29	Bangladesh	1010	Low	29	Djibouti	608.73	Low
30	Djibouti	1030	Lower middle	30	Chad	620.06	Low
31	Chad	1030	Low	31	Senegal	638.4	Low
32	Senegal	1050	Lower middle	32	Kenya	641.48	Low
33	Mauritania	1060	Lower middle	33	Mauritania	657.2	Low
34	Kenya	1160	Lower middle	34	Tajikistan	685.08	Low
35	Kyrgyzstan	1210	Lower	35	Lesotho	712.5	Low

			middle			
36	Cameroon	1290	Lower middle	36	Sao Tome and Principe	723.24 Low
37	Yemen	1330	Lower middle	37	Kyrgyzstan	771.98 Low
38	Pakistan	1360	Lower middle	38	Cote d'Ivoire	801.85 Low
39	Cote d'Ivoire	1450	Lower middle	39	Yemen	828.59 Low
40	Laos	1450	Lower middle	40	Cameroon	835.92 Low
41	Sao Tome and Principe	1470	Lower middle	41	Nicaragua	895 Low
42	Lesotho	1500	Lower middle	42	Zambia	905 Low
43	Sudan	1550	Lower middle	43	Laos	917.85 Low
44	India	1570	Lower middle	44	Pakistan	943.84 Low
45	Vietnam	1740	Lower middle	45	Honduras	981 Low
46	Ghana	1770	Lower middle	46	Papua New Guinea	991.82 Low
47	Nicaragua	1790	Lower middle	47	India	992.24 Low
48	Zambia	1810	Lower middle	48	Sudan	1002.85 Low
49	Syrian Arab Republic	1850	Lower middle	49	Ghana	1047.84 Lower middle
50	Uzbekistan	1880	Lower middle	50	Vietnam	1120.56 Lower middle
51	Papua New Guinea	2020	Lower middle	51	Uzbekistan	1133.64 Lower middle
52	Honduras	2180	Lower middle	52	Bolivia	1173 Lower middle
53	Bhutan	2330	Lower middle	53	Syrian Arab Republic	1258 Lower middle
54	Moldova	2470	Lower middle	54	Congo	1364.93 Lower middle
55	Bolivia	2550	Lower middle	55	Swaziland	1450.15 Lower middle
56	Congo	2590	Lower middle	56	Bhutan	1514.5 Lower middle
57	Nigeria	2710	Lower middle	57	Nigeria	1536.57 Lower middle
58	Swaziland	2990	Lower middle	58	Guatemala	1569.8 Lower middle
59	Morocco	3020	Lower middle	59	Moldova	1654.9 Lower middle
60	Palestine	3070	Lower middle	60	Cape Verde	1791.9 Lower middle
61	Egypt	3140	Lower middle	61	Philippines	1805.04 Lower middle
62	Sri Lanka	3170	Lower middle	62	Sri Lanka	1892.49 Lower middle
63	Philippines	3270	Lower middle	63	Palestine	1980.15 Lower middle
64	Micronesia	3280	Lower middle	64	Paraguay	2005 Lower middle
65	Guatemala	3340	Lower middle	65	Morocco	2023.4 Lower middle
66	Georgia	3560	Lower middle	66	Georgia	2100.4 Lower middle
67	Indonesia	3580	Lower middle	67	Indonesia	2112.2 Lower middle
68	Cape Verde	3620	Lower middle	68	El Salvador	2120.4 Lower middle
69	El Salvador	3720	Lower middle	69	Belize	2255 Lower middle
70	Guyana	3750	Lower middle	70	Angola	2326.5 Lower middle
71	Mongolia	3770	Lower	71	Namibia	2365.61 Lower

			middle			middle	
72	Armenia	3800	Lower middle	72	Egypt	2386.4	Lower middle
73	Timor-Leste	3940	Lower middle	73	Armenia	2390.2	Lower middle
74	Ukraine	3960	Lower middle	74	Mongolia	2393.95	Lower middle
75	Paraguay	4010	Lower middle	75	Micronesia	2394.4	Lower middle
76	Tunisia	4200	Upper middle	76	Guyana	2437.5	Lower middle
77	Fiji	4370	Upper middle	77	Tunisia	2461.2	Lower middle
78	Belize	4510	Upper middle	78	Fiji	2499.64	Lower middle
79	Albania	4510	Upper middle	79	Timor-Leste	2683.14	Lower middle
80	Bosnia and Herzegovina	4780	Upper middle	80	Macedonia	2766.16	Lower middle
81	Macedonia	4870	Upper middle	81	Jamaica	2844.9	Lower middle
82	Jordan	4950	Upper middle	82	Ukraine	2914.56	Lower middle
83	Angola	5170	Upper middle	83	Albania	2954.05	Lower middle
84	Jamaica	5220	Upper middle	84	South Africa	3008.46	Lower middle
85	Algeria	5330	Upper middle	85	Bosnia and Herzegovina	3049.64	Lower middle
86	Thailand	5340	Upper middle	86	Ecuador	3052.8	Lower middle
87	Maldives	5600	Upper middle	87	Thailand	3161.28	Lower middle
88	Ecuador	5760	Upper middle	88	Dominican Republic	3173.5	Lower middle
89	Dominican Republic	5770	Upper middle	89	Jordan	3197.7	Lower middle
90	Iran	5780	Upper middle	90	Botswana	3317.79	Lower middle
91	Namibia	5870	Upper middle	91	Peru	3448.5	Lower middle
92	Serbia	6050	Upper middle	92	Algeria	3448.51	Lower middle
93	Peru	6270	Upper middle	93	China	3450.56	Lower middle
94	Argentina	6290	Upper middle	94	Maldives	3528	Lower middle
95	China	6560	Upper middle	95	Suriname	3560.6	Lower middle
96	Iraq	6720	Upper middle	96	Iran	3566.26	Upper middle
97	Belarus	6730	Upper middle	97	Argentina	3711.1	Lower middle
98	Turkmenistan	6880	Upper middle	98	Colombia	3924.03	Lower middle
99	Saint Lucia	7060	Upper middle	99	Saint Lucia	4052.44	Upper middle
100	Montenegro	7250	Upper middle	100	Serbia	4368.1	Upper middle
101	Azerbaijan	7350	Upper middle	101	Iraq	4643.52	Upper middle
102	Bulgaria	7360	Upper middle	102	Bulgaria	4776.64	Upper middle
103	South Africa	7410	Upper middle	103	Azerbaijan	4873.05	Upper middle
104	Colombia	7590	Upper middle	104	Belarus	4980.2	Upper middle
105	Botswana	7770	Upper middle	105	Turkmenistan	5056.8	Upper middle
106	Romania	9050	Upper middle	106	Montenegro	5075	Upper middle
107	Suriname	9370	Upper	107	Costa Rica	5157	Upper

			middle			middle
108	Costa Rica	9550	Upper	108	Panama	5457
			middle			Upper
109	Mauritius	9570	Upper	109	Brazil	5611.2
			middle			middle
110	Lebanon	9870	Upper	110	Malaysia	5611.34
			middle			Upper
111	Mexico	9940	Upper	111	Mexico	5616.1
			middle			middle
112	Malaysia	10430	Upper	112	Mauritius	5856.84
			middle			Upper
113	Gabon	10650	Upper	113	Romania	6045.4
			middle			middle
114	Panama	10700	Upper	114	Lebanon	6218.1
			middle			Upper
115	Turkey	10970	Upper	115	Gabon	6230.25
			middle			middle
116	Kazakhstan	11550	Upper	116	Turkey	6461.33
			middle			Upper
117	Brazil	11690	Upper	117	Chile	7219.02
			middle			middle
118	Venezuela	12550	Upper	118	Seychelles	7939.21
			middle			Upper
119	Seychelles	13210	High	119	Barbados	7992.4
						middle
120	Poland	13240	High	120	Venezuela	8032
						Upper
121	Hungary	13260	High	121	Kazakhstan	8200.5
						middle
122	Croatia	13420	High	122	Puerto Rico	8490.82
						Upper
123	Russia	13850	High	123	Uruguay	8652.6
						middle
124	Lithuania	14900	High	124	Russia	8947.1
						Upper
125	Barbados	15080	High	125	Poland	9122.36
						middle
126	Uruguay	15180	High	126	Croatia	9259.8
						Upper
127	Chile	15230	High	127	Hungary	9706.32
						middle
128	Latvia	15290	High	128	Latvia	9800.89
						Upper
129	Estonia	17780	High	129	Lithuania	9997.9
						middle
130	Slovakia	17810	High	130	Estonia	12108.2
						Upper
131	Czech Republic	18970	High	131	Bahamas	12294.9
						middle
132	Puerto Rico	19210	High	132	Slovakia	13232.8
						High
133	Malta	20980	High	133	Portugal	13995.7
						High
134	Portugal	21270	High	134	Czech Republic	14189.6
						High
135	Bahamas	21570	High	135	Greece	15088.9
						High
136	Greece	22690	High	136	Malta	15231.5
						High
137	Slovenia	23220	High	137	Slovenia	17693.6
						High
138	Cyprus	25210	High	138	Cyprus	17873.9
						High
139	Spain	29940	High	139	Hong Kong	19632.6
						High
140	Israel	33930	High	140	Spain	19760.4
						High
141	Italy	35620	High	141	Israel	21172.3
						High
142	New Zealand	35760	High	142	Italy	24257.2
						High
143	Hong Kong	38420	High	143	New Zealand	24424.1
						High
144	United Kingdom	41680	High	144	United Kingdom	27925.6
						High
145	Ireland	43090	High	145	United States	27964.8
						High
146	France	43520	High	146	Singapore	28208.9
						High
147	Iceland	46290	High	147	France	30115.8
						High
148	Japan	46330	High	148	Ireland	30421.5
						High
149	Belgium	46340	High	149	Japan	30763.1
						High
150	Germany	47250	High	150	Germany	33547.5
						High



151	Finland	48820	High	151	Belgium	34152.6	High
152	Austria	50390	High	152	Australia	34727.4	High
153	Netherlands	51060	High	153	Iceland	35365.6	High
154	Canada	52210	High	154	Canada	35502.8	High
155	United States	53470	High	155	Finland	36224.4	High
156	Singapore	54040	High	156	Austria	37137.4	High
157	Denmark	61670	High	157	Netherlands	37886.5	High
158	Sweden	61710	High	158	Denmark	44525.7	High
159	Australia	65400	High	159	Sweden	46652.8	High
160	Luxembourg	69880	High	160	Luxembourg	50872.6	High
161	Qatar	86790	High	161	Qatar	61360.5	High
162	Switzerland	90680	High	162	Switzerland	63748	High
163	Norway	102700	High	163	Norway	79181.7	High

Next, we use equation (10) to adjust GNI per capita using the bottom 40% measure of inequality. The results are in table 3.

Table 3: Classification of Countries using an inequality-adjusted GNI per capita for the bottom 40% inequality

Position	Country	GNI per capita, atlas method	Ranking on the basis of GNI per capita atlas measure	Position	Country	GNI adjusted, in this case for bottom 40% inequality	Ranking on the basis of GNI adjusted, in this case for bottom 40% inequality
1	Burundi	260	Low	1	Zimbabwe	75.0574	Low
2	Malawi	270	Low	2	Central African Republic	81.92	Low
3	Central African Republic	320	Low	3	Malawi	100.9878	Low
4	Niger	400	Low	4	Burundi	135.33	Low
5	Liberia	410	Low	5	Democratic Republic of Congo	157.7025	Low
6	Democratic Republic of Congo	430	Low	6	Comoros	165.9	Low
7	Madagascar	440	Low	7	Gambia	166.875	Low
8	Guinea	460	Low	8	Haiti	182.25	Low
9	Ethiopia	470	Low	9	Liberia	182.3475	Low
10	Gambia	500	Low	10	Guinea	193.315	Low
11	Togo	530	Low	11	Madagascar	194.8261	Low
12	Guinea-Bissau	590	Low	12	Rwanda	196.4025	Low
13	Uganda	600	Low	13	Niger	199.2	Low
14	Mozambique	610	Low	14	Mozambique	223.1075	Low
15	Rwanda	630	Low	15	Ethiopia	243.3425	Low
16	Sierra Leone	660	Low	16	Uganda	246.6145	Low
17	Mali	670	Low	17	Togo	256.52	Low
18	Afghanistan	690	Low	18	Guinea-Bissau	279.07	Low
19	Nepal	730	Low	19	Djibouti	311.8469	Low

20	Burkina Faso	750	Low	20	Cambodia Burkina Faso	312.0943	Low
21	Benin	790	Low	21	Mali	324.375	Low
22	Haiti	810	Low	22	Nepal	334.33	Low
23	Comoros	840	Low	23	Benin	341.275	Low
24	Zimbabwe	860	Low	24	Bangladesh	352.1425	Low
25	Tanzania	860	Low	25	Lesotho	354.2575	Low
26	South Sudan	950	Low	26	Pakistan	381.7501	Low
27	Cambodia	950	Low	27	Afghanistan	391	Low
28	Tajikistan	990	Low	28	Kenya	396.9225	Low
29	Bangladesh	1010	Low	29	Tanzania	406	Low
30	Djibouti	1030	Lower middle	30	Chad	412.8	Low
31	Chad	1030	Low	31	Mauritania	428.995	Low
32	Senegal	1050	Lower middle	32	Senegal	440.4301	Low
33	Mauritania	1060	Lower middle	33	Honduras	441.7875	Low
34	Kenya	1160	Lower middle	34	Sao Tome and Principe	468.7001	Low
35	Kyrgyzstan	1210	Lower middle	35	Tajikistan	504.5775	Low
36	Cameroon	1290	Lower middle	36	Cote d'Ivoire	520.7401	Low
37	Yemen	1330	Lower middle	37	Cameroon	526.9637	Low
38	Pakistan	1360	Lower middle	38	Kyrgyzstan	546.315	Low
39	Cote d'Ivoire	1450	Lower middle	39	Nicaragua	551.155	Low
40	Laos	1450	Lower middle	40	Yemen	554.9	Low
41	Sao Tome and Principe	1470	Lower middle	41	Papua New Guinea	614.7925	Low
42	Lesotho	1500	Lower middle	42	Zambia	619.1301	Low
43	Sudan	1550	Lower middle	43	Bolivia	633.5001	Low
44	India	1570	Lower middle	44	Laos	650.25	Low
45	Vietnam	1740	Lower middle	45	Sudan	687.6624	Low
46	Ghana	1770	Lower middle	46	India	715.325	Low
47	Nicaragua	1790	Lower middle	47	Ghana	789.5825	Low
48	Zambia	1810	Lower middle	48	Vietnam	792.075	Low
49	Syrian Arab Republic	1850	Lower middle	49	Swaziland	823.89	Low
50	Uzbekistan	1880	Lower middle	50	Congo	853.645	Low
51	Papua New Guinea	2020	Lower middle	51	Uzbekistan	867.65	Low
52	Honduras	2180	Lower middle	52	Guatemala	877.02	Low
53	Bhutan	2330	Lower middle	53	Nigeria	918.4999	Low
54	Moldova	2470	Lower middle	54	Syrian Arab Republic	1002.7	Low
55	Bolivia	2550	Lower middle	55		1006.814	Lower middle

56	Congo	2590	Lower middle	56	Bhutan	1071.8	Lower middle
57	Nigeria	2710	Lower middle	57	Cape Verde	1126.725	Lower middle
58	Swaziland	2990	Lower middle	58	Philippines	1128.15	Lower middle
59	Morocco	3020	Lower middle	59	Paraguay	1213.025	Lower middle
60	Palestine	3070	Lower middle	60	Moldova	1234.383	Lower middle
61	Egypt	3140	Lower middle	61	Morocco	1258.585	Lower middle
62	Sri Lanka	3170	Lower middle	62	El Salvador	1348.5	Lower middle
63	Philippines	3270	Lower middle	63	South Africa	1357.883	Lower middle
64	Micronesia	3280	Lower middle	64	Sri Lanka	1370.233	Lower middle
65	Guatemala	3340	Lower middle	65	Belize	1386.825	Lower middle
66	Georgia	3560	Lower middle	66	Georgia	1395.52	Lower middle
67	Indonesia	3580	Lower middle	67	Palestine	1456.715	Lower middle
68	Cape Verde	3620	Lower middle	68	Micronesia	1459.6	Lower middle
69	El Salvador	3720	Lower middle	69	Indonesia	1601.397	Lower middle
70	Guyana	3750	Lower middle	70	Tunisia	1686.3	Lower middle
71	Mongolia	3770	Lower middle	71	Botswana	1705.515	Lower middle
72	Armenia	3800	Lower middle	72	Mongolia	1720.063	Lower middle
73	Timor-Leste	3940	Lower middle	73	Fiji	1755.647	Lower middle
74	Ukraine	3960	Lower middle	74	Macedonia	1779.985	Lower middle
75	Paraguay	4010	Lower middle	75	Egypt	1789.8	Lower middle
76	Tunisia	4200	Upper middle	76	Jamaica	1871.37	Lower middle
77	Fiji	4370	Upper middle	77	Armenia	1919	Lower middle
78	Belize	4510	Upper middle	78	Maldives	1960	Lower middle
79	Albania	4510	Upper middle	79	Ecuador	1972.8	Lower middle
80	Bosnia and Herzegovina	4780	Upper middle	80	Dominican Republic	2033.925	Lower middle
81	Macedonia	4870	Upper middle	81	Colombia	2049.3	Lower middle
82	Jordan	4950	Upper middle	82	Suriname	2061.4	Lower middle
83	Angola	5170	Upper middle	83	Namibia	2069.175	Lower middle
84	Jamaica	5220	Upper middle	84	Timor-Leste	2108.885	Lower middle
85	Algeria	5330	Upper middle	85	Bosnia and Herzegovina	2146.22	Lower middle
86	Thailand	5340	Upper middle	86	Peru	2147.475	Lower middle
87	Maldives	5600	Upper middle	87	Angola	2197.25	Lower middle
88	Ecuador	5760	Upper middle	88	Thailand	2269.5	Lower middle

89	Dominican Republic	5770	Upper middle	89	Albania	2276.423	Lower middle
90	Iran	5780	Upper middle	90	Ukraine	2338.38	Lower middle
91	Namibia	5870	Upper middle	91	Jordan	2385.9	Lower middle
92	Serbia	6050	Upper middle	92	Argentina	2437.375	Lower middle
93	Peru	6270	Upper middle	93	Algeria	2467.79	Lower middle
94	Argentina	6290	Upper middle	94	Iran	2505.63	Lower middle
95	China	6560	Upper middle	95	Saint Lucia	2665.15	Lower middle
96	Iraq	6720	Upper middle	96	Panama	3263.5	Lower middle
97	Belarus	6730	Upper middle	97	Costa Rica	3342.5	Lower middle
98	Turkmenistan	6880	Upper middle	98	Bulgaria	3385.6	Lower middle
99	Saint Lucia	7060	Upper middle	99	Brazil	3390.1	Lower middle
100	Montenegro	7250	Upper middle	100	Serbia	3412.2	Lower middle
101	Azerbaijan	7350	Upper middle	101	Malaysia	3439.292	Lower middle
102	Bulgaria	7360	Upper middle	102	Mexico	3578.4	Lower middle
103	South Africa	7410	Upper middle	103	Iraq	3603.6	Lower middle
104	Colombia	7590	Upper middle	104	Azerbaijan	3689.7	Lower middle
105	Botswana	7770	Upper middle	105	China	3722.8	Lower middle
106	Romania	9050	Upper middle	106	Belarus	3869.75	Lower middle
107	Suriname	9370	Upper middle	107	Montenegro	3920.437	Upper middle
108	Costa Rica	9550	Upper middle	108	Romania	4276.125	Upper middle
109	Mauritius	9570	Upper middle	109	Gabon	4334.55	Upper middle
110	Lebanon	9870	Upper middle	110	Turkey	4560.777	Upper middle
111	Mexico	9940	Upper middle	111	Puerto Rico	4610.4	Upper middle
112	Malaysia	10430	Upper middle	112	Chile	4873.6	Upper middle
113	Gabon	10650	Upper middle	113	Barbados	4901	Upper middle
114	Panama	10700	Upper middle	114	Seychelles	5214.647	Upper middle
115	Turkey	10970	Upper middle	115	Venezuela	5584.75	Upper middle
116	Kazakhstan	11550	Upper middle	116	Uruguay	5768.4	Upper middle
117	Brazil	11690	Upper middle	117	Mauritius	5817.121	Upper middle
118	Venezuela	12550	Upper middle	118	Russia	5820.462	Upper middle
119	Seychelles	13210	High	119	Kazakhstan	6430.462	Upper middle
120	Poland	13240	High	120	Croatia	6810.65	Upper middle
121	Hungary	13260	High	121	Poland	6917.9	Upper middle
122	Croatia	13420	High	122	Latvia	6995.175	Upper middle
123	Russia	13850	High	123	Lithuania	7226.5	Upper middle
124	Lithuania	14900	High	124	Hungary	7723.95	Upper middle
125	Barbados	15080	High	125	Bahamas	8951.551	Upper middle
126	Uruguay	15180	High	126	Estonia	8978.9	Upper middle
127	Chile	15230	High	127	Portugal	10422.3	Upper middle

128	Latvia	15290	High	128	Slovakia	10686	Upper middle
129	Estonia	17780	High	129	Greece	10891.2	Upper middle
130	Slovakia	17810	High	130	Czech Republic	11713.98	Upper middle
131	Czech Republic	18970	High	131	Malta	11906.15	Upper middle
132	Puerto Rico	19210	High	132	Israel	12651.65	Upper middle
133	Malta	20980	High	133	Hong Kong	13062.8	High
134	Portugal	21270	High	134	Spain	13772.4	High
135	Bahamas	21570	High	135	Cyprus	13928.53	High
136	Greece	22690	High	136	Slovenia	14338.35	High
137	Slovenia	23220	High	137	New Zealand	14348.7	High
138	Cyprus	25210	High	138	United States	16575.7	High
139	Spain	29940	High	139	Italy	17899.05	High
140	Israel	33930	High	140	Canada	18012.45	High
141	Italy	35620	High	141	Singapore	20772.87	High
142	New Zealand	35760	High	142	United Kingdom	21152.6	High
143	Hong Kong	38420	High	143	Ireland	21437.28	High
144	United Kingdom	41680	High	144	France	23827.2	High
145	Ireland	43090	High	145	Japan	25587.91	High
146	France	43520	High	146	Germany	26105.62	High
147	Iceland	46290	High	147	Belgium	26877.2	High
148	Japan	46330	High	148	Finland	29169.95	High
149	Belgium	46340	High	149	Iceland	29394.15	High
150	Germany	47250	High	150	Austria	29856.08	High
151	Finland	48820	High	151	Netherlands	30636	High
152	Austria	50390	High	152	Denmark	34997.73	High
153	Netherlands	51060	High	153	Australia	35479.5	High
154	Canada	52210	High	154	Sweden	37488.82	High
155	United States	53470	High	155	Luxembourg	39831.6	High
156	Singapore	54040	High	156	Switzerland	49647.3	High
157	Denmark	61670	High	157	Norway	65728	High
158	Sweden	61710	High	158			
159	Australia	65400	High	159			
160	Luxembourg	69880	High	160			
161	Qatar	86790	High	161			
162	Switzerland	90680	High	162			
163	Norway	102700	High	163			

The bottom ranked countries in terms of inequality adjusted GNI per capita, adjusted using the bottom 40% measure are Zimbabwe, Central African Republic, Malawi, Burundi, DRC, Comoros, Gambia, Haiti, Liberia, Guinea. On the other hand the top countries are Norway, Switzerland, Luxembourg, Sweden, Australia, Denmark, Netherlands, Austria, Iceland, and Finland.

## Chapter 5: Results for DALY-adjusted GNI per Capita

### 5.1 The Data

The main source data for GNI per capita that are internationally comparable, is the World Bank.. First, they provide a source of GNI per capita, converted to international dollars using purchasing power parity (PPP) rates, in constant 2011 international dollars. In addition to this, the World Bank provides GNI per capita data on the basis of the so-called Atlas method, which essentially converts GNI in national currency to US dollars using a conversion or smoothing factor to average out exchange rate and price fluctuations. This is also the source that the World Bank uses itself for its country classification. Yet, it does not seem to be in constant dollars and hence does not account for price changes over time within countries. The number of observations is higher for the Atlas method corrected measure (2303 vs. 3535 for the full from 1995 onwards sample). The correlation between the two measures is high (0.89) for our full sample (post 1995), but the correlation for changes in GNI per capita within countries is considerably lower (0.49).

The source for the data on DALY, and related measures such as health adjusted life expectancy(HALE) by country, gender, age, disease or injury or risk factors is Murray, Vos et al. 2012; <http://www.healthdata.org/>, Global Burden of Disease Study 2013 Collaborators 2015).

### 5.2 DALY-adjusted GNI per Capita Measure

Using expression (12), we calculate the health inequality adjusted GNI per capita, **(1-DALY)\*GNI per capita**). Countries' new ranking is reported in table 4.

Table 4: Adjusted GNI per capita using the DALY, HALE and Strict Financial Index

Country	HALE	HALE adjusted GNI	Strict Index	GNI adjusted with Strict	DALY adjusted GNI	GNI Ranking	DALY adjusted GNI Ranking	HALE adjusted GNI Ranking	GNI adjusted with Strict Index Ranking
Slovenia	69.14	1989849	0.7703202	22169.81	28418.16	1	1	1	1
Czech Republic	67.73	1811100	0.7450949	19923.84	26280.71	2	2	2	2
Trinidad and Tobago	62.71	1644256	0.5806519	15224.69	24896.25	3	4	5	9
Slovakia	66.61	1739187	0.7108384	18559.99	25600.84	4	3	3	3
Estonia	66.98	1645699	0.6982762	17156.64	24086.59	5	5	4	4
Lithuania	65.82	1615881	0.6187513	15190.34	24008.41	6	6	6	10
Russia	62.8	1456332	0.5208898	12079.43	22037.29	7	9	11	17
Hungary	66.23	1510044	0.6480803	14776.23	22478.66	8	7	8	12
Poland	66.96	1526018	0.6950507	15840.2	22401.61	9	8	7	6
Malaysia	66.34	1494640	0.7092138	15978.59	21417.45	10	11	9	5
Latvia	66.35	1493539	0.6051845	13622.7	21971.29	11	10	10	15
Chile	69.07	1452542	0.7267926	15284.45	20625.9	12	12	12	7

Croatia	68.11	1418731	0.7330117	15268.63	20568.84	13	13	13	8
Kazakhstan	60.22	1245350	0.5557753	11493.43	19652.04	14	14	16	18
Panama	67.51	1302943	0.737556	14234.83	18220.78	15	16	14	13
Uruguay	67.44	1277314	0.7461718	14132.49	18408.34	16	15	15	14
Turkey	65.97	1240236	0.7880412	14815.17	18108.64	17	17	17	11
Romania	66.42	1222792	0.6865777	12639.9	17927.13	18	18	18	16
Venezuela	65.67	1175493	0.4884158	8742.643	17139.48	19	19	19	30
Gabon	51.27	883382.1	0.493968	8511.067	11503.9	20	32	29	32
Belarus	62.21	1054460	0.5885628	9976.14	16525.57	21	20	21	24
Azerbaijan	63.46	1026783	0.4310484	6974.362	15166.17	22	22	22	40
Mexico	65.83	1060521	0.6284781	10124.78	15539.34	23	21	20	23
Botswana	56.3	880532	0.6803464	10640.62	10997.95	24	35	30	20
Bulgaria	65.17	991235.7	0.5761786	8763.677	14871.65	25	23	23	29
Iraq	61.45	917448.5	0.639536	9548.271	13492.89	26	26	27	26
Brazil	64.89	957127.5	0.6878662	10146.03	14083.15	27	25	24	22
Montenegro	66.25	954662.5	0.6042902	8707.822	14175.63	28	24	25	31
Costa Rica	69.05	937008.6	0.7895208	10713.8	13246.35	29	27	26	19
Thailand	66.7	895780.9	0.7698137	10338.6	12650.84	30	28	28	21
Algeria	65.96	862097.2	0.7400249	9672.126	12239.62	31	30	31	25
Serbia	68.02	848889.6	0.5889748	7350.406	12292.79	32	29	32	38
South Africa	52.02	636724.8	0.6074429	7435.101	7992.309	33	47	45	35
Colombia	65.39	782064.4	0.7868504	9410.73	11399.71	34	33	34	27
China	67.89	804496.5	0.6963633	8251.905	11516.91	35	31	33	33
Jordan	66.46	775588.2	0.760409	8873.973	11076.93	36	34	35	28
Dominican Republic	64.65	751879.5	0.6387811	7429.024	10848.48	37	36	36	37
Peru	66.09	737564.4	0.6722957	7502.82	10506.58	38	37	37	34
Egypt	61.62	664879.8	0.4939708	5329.945	10143.74	39	39	42	48
Ecuador	65.33	700337.6	0.601002	6442.742	10034.6	40	41	39	42
Tunisia	67.36	714689.6	0.7004359	7431.625	10199.06	41	38	38	36
Albania	66.09	687335.9	0.5572803	5795.715	10100.7	42	40	41	46
Maldives	69.67	689733	0.7410747	7336.64	9525.089	43	42	40	39
Bosnia	67.65	653499	0.6846132	6613.364	9513.865	44	43	43	41
Namibia	52.96	502590.4	0.6426103	6098.372	7463.45	45	50	50	44
Sri Lanka	67.29	637236.3	0.6122574	5798.078	9079.09	46	44	44	45
Indonesia	62.89	582990.3	0.5717718	5300.325	8369.211	47	46	46	49
Ukraine	63.07	565737.9	0.5419392	4861.195	8537.32	48	45	47	52
Jamaica	65.95	559915.5	0.7237059	6144.264	7893.033	49	49	48	43
Armenia	65.16	533008.8	0.5411231	4426.387	7898.149	50	48	49	53
Belize	61.66	485264.2	0.7056259	5553.276	7386.626	51	51	52	47
Philippines	61.57	482708.8	0.495292	3883.089	7033.666	52	55	53	58
Paraguay	64.47	494484.9	0.5530506	4241.898	7209.708	53	52	51	56
Fiji	59.15	448948.5	0.6662253	5056.65	7098.168	54	53	57	51
El Salvador	63.72	477262.8	0.6895961	5165.075	7075.713	55	54	54	50
Guatemala	62.05	442416.5	0.4740541	3380.006	6239.069	56	58	58	60
Georgia	64.35	453024	0.4688823	3300.931	6776.687	57	56	55	61

Angola	52.35	366450	0.4476578	3133.605	1498.036	58	80	61	62
Morocco	64.31	450170	0.4970956	3479.669	6404.416	59	57	56	59
Bhutan	60.82	420874.4	0.6328208	4379.12	6121.682	60	59	59	54
Cape Verde	64.64	401414.4	0.6994731	4343.728	5709.68	61	60	60	55
Swaziland	43.87	265852.2	0.4949169	2999.196	2891.668	62	68	69	64
Bolivia	62.9	361675	0.6959459	4001.689	4952.911	63	61	62	57
Nigeria	51.24	274646.4	0.2449873	1313.132	1934.958	64	74	67	75
India	57.73	308855.5	0.4094643	2190.634	4484.179	65	63	64	67
Vietnam	66.6	337662	0.5968786	3026.175	4759.957	66	62	63	63
Pakistan	57.09	276315.6	0.4077226	1973.377	3730.063	67	66	66	69
Lao	58.11	264400.5	0.4619779	2102	3488.562	68	67	70	68
Nicaragua	64.02	288730.2	0.6536025	2947.748	4221.201	69	64	65	65
Honduras	62.75	267942.5	0.5855448	2500.276	3916.175	70	65	68	66
Ghana	56.94	222066	0.5058437	1972.79	2638.719	71	72	72	70
Yemen	58.42	223164.4	0.3136776	1198.248	2873.504	72	69	71	80
Zambia	49.12	187147.2	0.466239	1776.371	1765.377	73	77	75	72
Bangladesh	59.9	191081	0.3803746	1213.395	2793.903	74	71	73	78
Lesotho	42.01	132751.6	0.4360326	1377.863	1225.963	75	83	81	73
Cote d'Ivoire	51.21	158238.9	0.3730407	1152.696	1303.859	76	82	78	81
Kyrgyzstan	60.95	187726	0.629178	1937.868	2854.43	77	70	74	71
Cambodia	57.51	171379.8	0.437879	1304.88	2515.369	78	73	76	77
Mauritania	56.49	160996.5	0.4581749	1305.798	1826.372	79	75	77	76
Kenya	56.57	157264.6	0.4320489	1201.096	1655.258	80	78	79	79
Cameroon	50.99	141242.3	0.3398771	941.4595	1397.382	81	81	80	83
Papua New Guinea	53.76	130636.8	0.5532376	1344.367	1809.497	82	76	82	74
Senegal	57.16	126323.6	0.5100483	1127.207	1542.46	83	79	83	82
Chad	49.08	98160	0.2301389	460.2779	402.9724	84	101	85	97
Benin	56.53	100623.4	0.5122304	911.7701	1073.331	85	85	84	84
Tanzania	53.96	94969.6	0.4454407	783.9756	1116.841	86	84	86	87
Sierra Leone	50.29	84990.1	0.3204252	541.5186	211.8789	87	104	88	92
Gambia	56.21	90498.1	0.5176356	833.3933	973.2814	88	90	87	86
Mali	49.98	76969.2	0.2911969	448.4433	621.8785	89	94	92	99
Comoros	55.75	83067.5	0.5100663	759.9988	1002.741	90	87	89	88
Uganda	51.39	75543.3	0.4364885	641.6381	810.312	91	92	94	91
Rwanda	55.36	80272	0.5865704	850.527	1043.613	92	86	90	85
Burkina Faso	54.07	77860.8	0.467567	673.2964	762.2377	93	93	91	89
Guinea-Bissau	46.22	65170.2	0.3181319	448.566	559.8479	94	97	97	98
Ethiopia	54.3	74934	0.3798665	524.2158	925.3954	95	91	95	95
Madagascar	55.41	75911.7	0.4852449	664.7855	978.6891	96	89	93	90
Togo	54.73	64581.4	0.4387895	517.7717	620.588	97	95	98	96
Nepal	61.43	71258.8	0.4580411	531.3277	993.5746	98	88	96	94
Guinea	52.44	60830.4	0.336897	390.8005	580.0304	99	96	99	102
Mozambique	48.1	52910	0.4918487	541.0336	454.6256	100	99	100	93
Niger	53.81	47890.9	0.2920919	259.9618	370.8463	101	102	101	105
Liberia	53.59	42336.1	0.5101151	402.9909	496.4556	102	98	102	101



Burundi	52.12	40132.4	0.485912	374.1522	341.4109	103	103	103	103
Malawi	49.61	37207.5	0.5397517	404.8138	406.9644	104	100	104	100
Congo, Dem Rep	49.2	36408	0.4421995	327.2276	181.6691	105	105	105	104

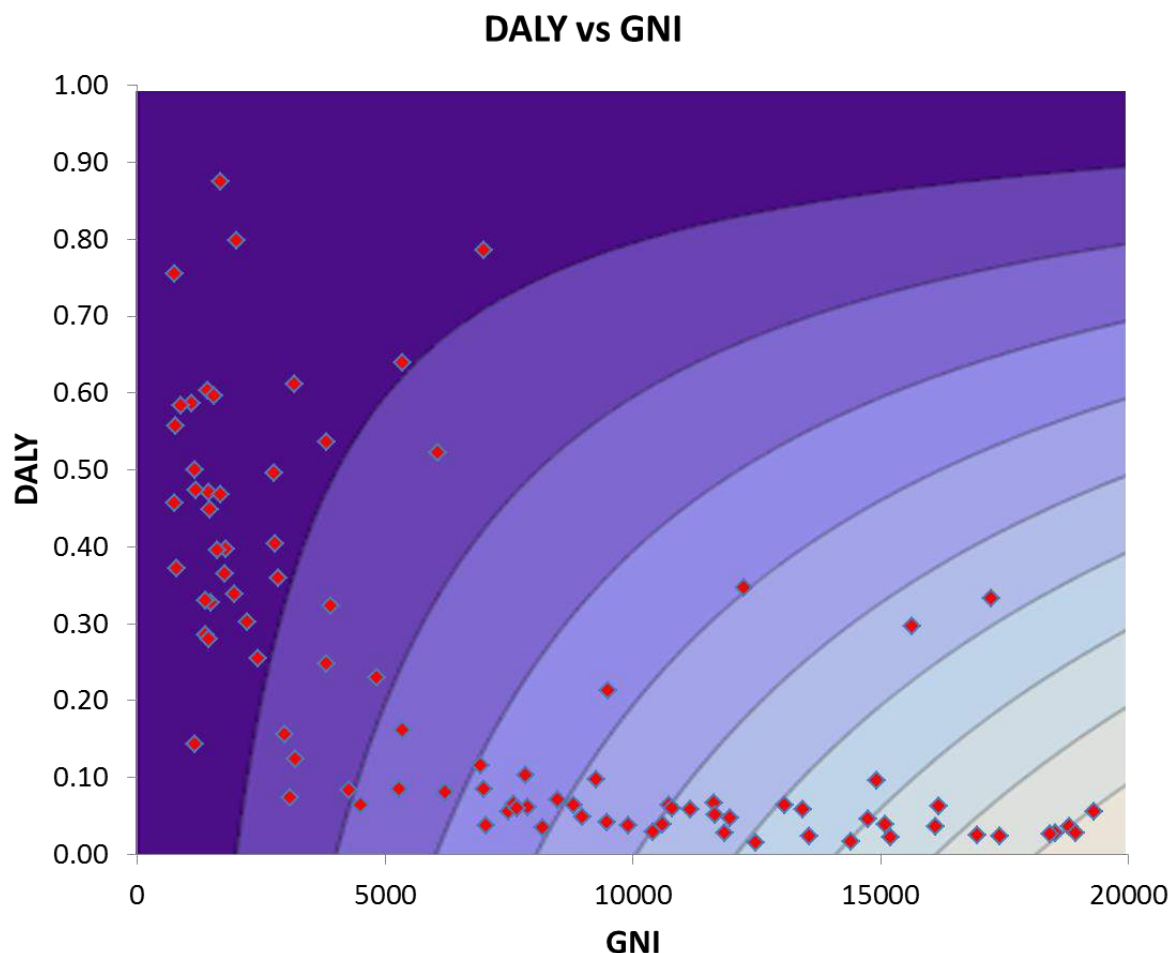
Middle-income countries generally change rankings when GNI per capita is adjusted using DALYs lost. The middle-income countries that drop in ranking due to high disease burden, poor health quality and vulnerability to specific diseases such as HIV/AIDS, include:

- Botswana
- Gabon
- South Africa
- Namibia
- Angola
- Nigeria

Some low-income countries such as Lesotho, Cote d'Ivoire and Chad also drop in ranking, again reflecting the high disease burden and poor health outcomes.

On the contrary, Rwanda, Nepal and Madagascar re-rank upwards given its relatively good progress in health delivery.

In figure 3, the curved lines represent the “indifference curves”, that is, pairs of GNI per capita and DALY for which the level of health development is the same



**Figure 3 – Health development according to the formula,  $GNI \text{ per capita} * (1 - DALY)$**

## 5.6 DALYS vs HALE adjustment in GNI per Capita

As a robustness check, we now compare the GNI per capita adjustment using the Health Adjusted Life Expectancy (HALE) and compare with DALY-based adjustment.

Health-adjusted life expectancy (HALE) was developed by the World Health Organization and attempts to capture a more realistic estimate of health than standard life expectancy rates (note that HALE was previously referred to as Disability-Adjusted Life Expectancy or DALE). HALE estimates the number of healthy years an individual is expected to live at birth by subtracting the years of ill health – weighted according to severity – from overall life expectancy. By going beyond mortality data, HALE is meant to measure not just how long people live, but to capture the quality of their health through their lives.

For the adjustment using the HALE indicators we use the formula, **HALE\*GNI per Capita.**

The results for the HALE-based adjustment versus DALY-based adjustment are shown in table 4. The results for the ranking of countries are very similar. We recommend the use of DALYs for adjustment given that it is more comprehensive than the HALE.

## 5.4 Adjustment using the ‘Strict’ Health Development Index

GNI per capita could also be adjusted using an index of financial access and risk protection for health needs. We make use of the ‘strict’ health development index calculated by Sheffield University and Imperial College, who are part of the EAI technical team. This index focuses on: (a) access to care measured through total and unmet health needs; (b) financial protection measured by reliance on pooled prepaid health financing. Therefore, the “strict” health development index encompassing only the dimension-specific indices of access to care and financial protection.

The GNI per Capita adjusted using the Strict Index is given by **Strict Index\*GNI per Capita**.

The results are shown in table 4. The results show that the adjusted GNI using the Strict index shows notable re-ranking downwards in high-income and middle-income countries such as Venezuela, Azerbaijan, Botswana, Gabon, South Africa, among others. Improved re-rankings are in countries such as Rwanda, Thailand, and Costa Rica.

## 5.5 Tax Revenue and Private Expenditure Considerations

Given our objective, we do not rescale GNI per capita to take into account tax capacity. Two reasons motivate our choice. First, the rates of tax collection are expected to be endogenous to international aid flows and hence problematic to include as an input in a method that seeks to determine aid flows. Second, our objective is to focus on the medium-term ability of countries to finance health care. If our objective were to measure the short-run ability of a country to finance health care, tax capacity would then be taken into account, as countries cannot dramatically increase their tax revenues. Their capacity to finance health care in the short run is limited by their ability to collect taxes.

## Chapter 6: The World Health Index

As part of our approach, we also propose to incorporate a World Health Index (WHI) to track progress on various health indicators across the world and over time. The WHO will also enable one to track the quality of health systems. The index can also be tailored to focus on the key mission of each health institutions, including the bias towards key population groups.

### 6.1 Tailored Index for each institution

The WHI can also be tailored to reflect the main objectives for each global health organization.

- WHO would be interested in the whole WHI index, given its interest in the whole health sector.
- UNFPA would be interested in the WHI with a maternal mortality bias given the interest in family planning.
- Global Fund would be interested in a WHI index with an HIV, Malaria, TB bias.
- GAVI would be interest in the whole WHI index.
- UNICEF would be interested in a WHI that is tilted towards child-mortality and neo-natal mortality
- Development finance institutions such as World Bank, and bilateral donors such as DfID, and non-profit funders such as Bill and Melinda gates foundation would be interested in the whole WHI index, given their concern for the entire health sector.
- UNAIDS would be interested in HIV/AIDS bias in the index

Each organization would make use of its customized index to track progress in the most affected countries.

### 6.2 Key population groups and Social norms

The index can also be used to capture the conditions of countries vis a vis key populations such as the gay community. In countries such as Uganda, for example, this community has been outlawed and this makes it difficult to target them on health issues, such as HIV treatment and prevention, and indeed in other health issues. This is captured in the WHI using the indicator of **Voice and Accountability**.

In some countries, the disease burden and health system affects women disproportionately. This may also be due to attitudes towards women or social norms and behavior by older men to **teenage girls**. Teenage girls are a key population, for example, where the HIV incidence rate remains high if not rising. This we capture using the indicator of **female literacy (number of years in schooling)**.

Yet another key population group with regard to HIV is **sex-workers**. Here, the inclusion of poverty measure and also female literacy may capture the potential size of the key group. It is assumed that the lack of education and skills among women would drive the growth and size of this key group.

### 6.3 The value chain on access to health

To put the WHI into context there is need to understand the concept value chain to access to health.

For countries, the “production” of a healthy population is a complex process which involves several inputs and intermediary outputs. A simplified vision of this process is represented in Figure 10. This diagram will inform our understanding in the construction of the WHI.

Going from top to bottom are the different steps needed to produce a healthy population, from inputs to health outcomes. Financial resources and assets are represented on the left-hand side of the diagram, while contextual factors are represented on the right-hand side. In red, we report indicators that can be used to measure the different factors of the production process.

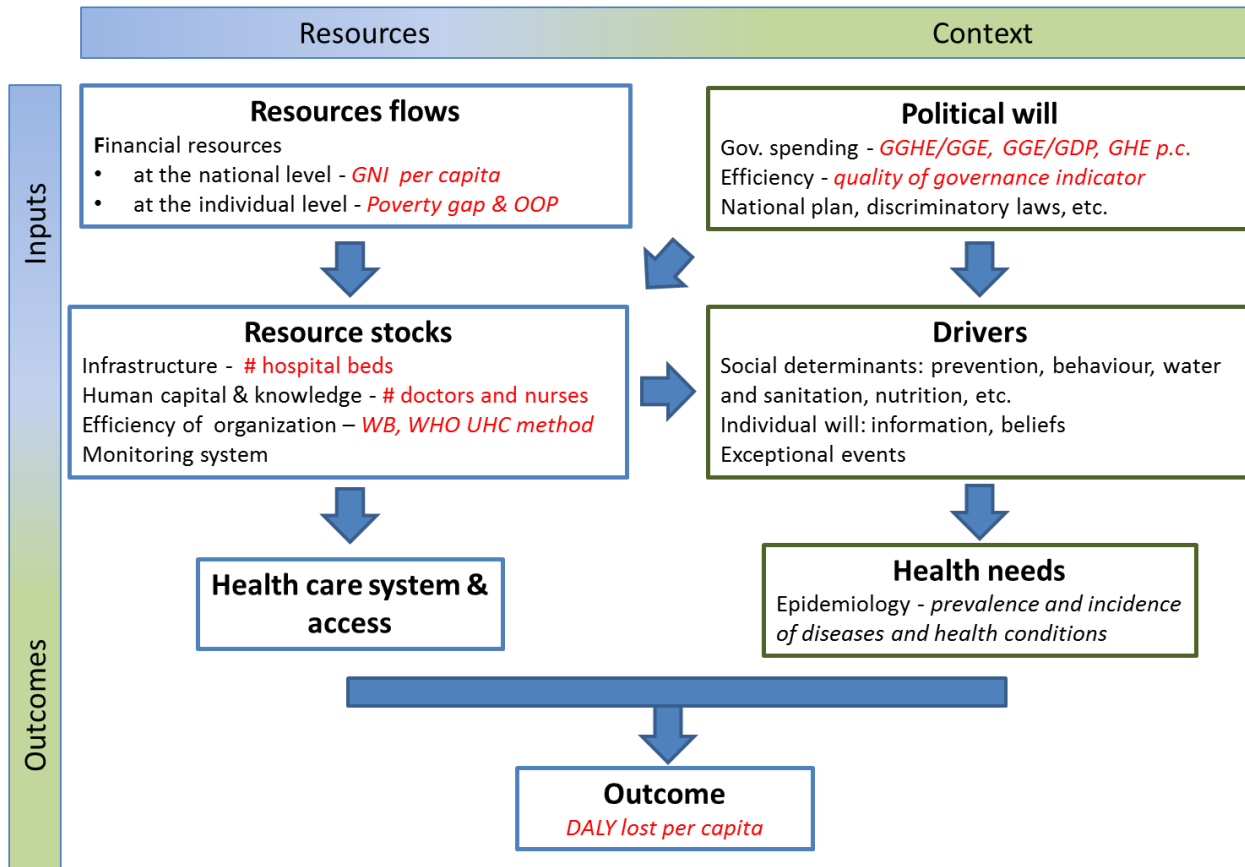
Two main primary inputs are required for investing in health: financial resources and political will. These inputs are necessary factors: they are both required for the production of health to be possible.

Financial barriers can be present at two levels. First, at the individual level and in the short run, individuals who do not have the means to pay for out-of-pocket expenditures for healthcare are at high risk of being health constrained. In the short run, people need a certain level of revenue to be able to pay for health expenses. We will estimate which level of revenue is needed and argue that the poverty gap below this poverty line is a good measure of the short-run households’ inability to pay for their health. At the national level and in the long-run, governments can implement redistributive policies between households. We therefore argue that average income or GNI per capita is a good proxy to capture the long-run ability of government to finance an efficient health care system. We combine GNI per capita and the poverty gap into a single measure that shows the extent to which a country could lift its citizens above the poverty line.

The second primary input is the political will. Many studies have emphasized the need of strong leadership in the construction of an efficient health system. Strong political will for health should be reflected in government prioritization of health, in corruption indicators as well as in the elaboration of plans and laws that act in favor (or against) health promotion. Strong political leadership coupled with available financial resources is expected to generate investment in health which will accumulate over time. These stocks of investment include infrastructure (hospitals, beds) as well as human capital (doctors, nurses, professors, knowledge), as well as efficient management and monitoring systems. Altogether, these accumulated material and immaterial assets constitute the core of the health system. Political will is also expected to impact the key drivers of epidemics, catastrophic events, risky behavior and all health issues in general by influencing prevention and social determinants of health. The key drivers will directly affect health needs of the population.

Finally, the combination of a healthcare system and health needs will determine our main outcome of interest: a population in good or bad health. As explained above, a good proxy for health outcomes in a country is the average number of Disability-Adjusted-Life-Years (DALYs) lost per person in a population. In particular, we will argue that focusing on DALYs lost because of “Communicable, maternal, perinatal and nutritional conditions” is a very good proxy to capture the outcome of the complex relationship between the healthcare system and health needs.

## Access to health care: value chain



**Figure 4: value chain in the “production” of health**

We can capture the health production function by focusing only on financial inputs and outcomes. Financial inputs are captured by the poverty gap (short-run individual level) and GNI per capita (long-run national level). Outcomes are best captured by average DALY lost per capita. For a given level of financial resources available in a country, a certain level of health can be attained (efficient production). We can call this optimal trajectory for health the “health development path”. For each country, any deviation from the health development path reflects the presence of barriers or inefficiencies in the production of health. These barriers can arise because of a lack of political will, inefficient management, corruption, lack of investment in prevention, etc. Financial inputs, outcome and the health development path can be represented in a two-dimensional diagram representing the current state of health worldwide.

The *WHI* aims to capture different factors of production represented in Figure 4. This approach is in the spirit of the Multidimensional Poverty Index proposed by Oxford Poverty & Human Development Initiative and the United Nations Development Programme, the Human Development Index, and Social Progress Index. We will present an indicator to measure each factor of production and present them into a dashboard. We will then combine these indicators to obtain a unique scalar, the World Health Index (WHI), which measures health development, as well as health systems and their resilience.

The World Health Index is more encompassing and allows the identification of barriers. The cost of complexity is an unavoidable arbitrariness in the choice of indicators and weights, as well as data availability problems.

The indicators are summarized in one single measure, an index. The WHI should be highly correlated with the GNI per capita adjusted for access and quality of health services. The pillars for health include impact, access, disease burden, efficiency of systems, quality, and resource capacity, as shown in Figure 10. Therefore, some key (but not exhaustive) indicators include:

- **Impact/Quality: Child Mortality for under-fives**
- **Impact/Quality: Life Expectancy**
- **Impact/Quality: Maternal Mortality**
- **Human Capacity: No of doctors per 100 00 people**
- **Human Capacity: Number other health workers(nurses) per 10 000 people**
- **Infrastructure Capacity: No of beds per 1000 people**
- **Efficiency: Waiting times to see doctor**
- **Disease Burden: Malaria, TB, HIV etc. (DALYs)**
- **Capacity to pay: GNI per capita, poverty gap**
- **Voice and accountability: Key populations**
- **Social Norms/Values: Female literacy**
- **Inequality: Bottom 40% measure**
- **Poverty: Poverty headcount**

These indicators can be tracked and reported.

Next we construct a World health access index as follows:

*Step 1:* Since the components of the WHI are originally measured in different units, the observations are “standardized” or “normalized” to permit averaging, with the average regarded as a composite index. The normalization procedure used is the min–max formula applied to all observed values of each component during the period 2000–2013. This procedure adjusts the “normalized component” to take values between 0 and 100 over the indicated period. That is,

**(15) Normalized value = (Actual Value-Minimum Value)/(Maximum Value-Minimum Value)**

*Step 2:* A simple composite index is calculated as an average of normalized indicators. A more sophisticated way of weighting would be to use weights are based on the inverse of the standard deviation of each normalized component:  $y_t = (\sigma_{tot} / \sigma_x) * x_t$ ; where  $\sigma_{tot}$  is given by  $1/\sigma_{tot} = \sum_x (1/\sigma_x)$  and  $\sigma_x$  is the standard deviation of the normalized component  $x$ . The rationale for this approach is to reduce the impact of the most volatile components on the composite index, and consequently the volatility of the rankings of countries. However, in our illustrative approach below, we use a simple average of normalized indicators.

The Dashboard of Health Indicators and the WHI, are in table D1 in Annex D. The overall WHI and tailored indices are calculated as above, and shown in table 5.

**Table 5: Rankings of selected High Income and Middle-Income Countries**

Country	GNI per Capita	GNI Ranking	WHI Ranking	Change in Ranking
Azerbaijan	16180.00	52	58	-6
Bolivia	5750.00	93	82	11
Botswana	15640.00	54	109	-55
Chad	2000.00	114	128	-14
India	5350.00	96	93	3
Kyrgyzstan	3080.00	108	68	40
Rwanda	1450.00	123	107	16
South Africa	12240.00	64	98	-34
Swaziland	6060.00	92	104	-12
Venezuela	17900.00	50	69	-19

From table 5 and 6, the ranking of countries using the WHI shows dramatic re-ranking as compared to GNI per capita-based rankings. For example, Botswana drops 55 places and South Africa drops 34 places, when ranked using the WHI as compared to GNI per capita. Venezuela, Swaziland and Chad also drop in ranking when ranked using the WHI. India does not change much in ranking. However, Kyrgyzstan re-ranks upwards substantially, when the WHI is used. Bolivia, Rwanda, also re-rank upwards but rather mildly compared to Kyrgyzstan.

**Table 6: World Health Index (WHI): Overall Index and Tailored Indices**

Country	Global Fund UNAids WHI	Country	UNICEF WHI	Country	UNFPA WHI	Country	WHO, World Bank, Gates Foundation (Overall WHI)
Zambia	0.205	Chad	0.129	Angola	0.136	Angola	0.256
Mozambique	0.208	Angola	0.136	Chad	0.143	Mozambique	0.265
Uganda	0.227	Congo, Dem Rep	0.139	Congo, Dem Rep	0.156	Congo, Dem Rep	0.266



Burkina Faso	0.233	Niger	0.165	Cote d'Ivoire	0.157	Chad	0.267
Congo, Dem Rep	0.245	Zambia	0.170	Burundi	0.166	Cote d'Ivoire	0.273
Burundi	0.252	Uganda	0.179	Niger	0.178	Zambia	0.277
Cote d'Ivoire	0.261	Burkina Faso	0.181	Uganda	0.181	Burkina Faso	0.279
Niger	0.278	Burundi	0.181	Zambia	0.184	Sierra Leone	0.280
Chad	0.298	Sierra Leone	0.186	Burkina Faso	0.188	Burundi	0.299
Lesotho	0.301	Cote d'Ivoire	0.187	Mozambique	0.213	Niger	0.309
Zimbabwe	0.303	Mozambique	0.219	Lesotho	0.219	Uganda	0.314
Sierra Leone	0.315	Lesotho	0.233	Sierra Leone	0.228	Lesotho	0.317
Benin	0.321	Zimbabwe	0.247	Benin	0.232	Benin	0.344
Togo	0.322	Togo	0.251	Cameroon	0.245	Zimbabwe	0.347
Cameroon	0.326	Benin	0.255	Togo	0.245	Togo	0.357
Angola	0.329	Yemen	0.282	Mauritania	0.251	Cameroon	0.394
SãoTomé and Príncipe	0.351	Mauritania	0.284	Pakistan	0.254	Nigeria	0.400
Malawi	0.353	Trinidad and Tobago	0.286	Zimbabwe	0.256	Malawi	0.403
Tanzania	0.363	SãoTomé and Príncipe	0.294	Yemen	0.257	Mauritania	0.414
Botswana	0.386	Cameroon	0.295	Trinidad and Tobago	0.262	SãoTomé and Príncipe	0.424
Rwanda	0.393	Cambodia	0.297	Comoros	0.275	Tanzania	0.429
Trinidad and Tobago	0.396	Malawi	0.307	Cambodia	0.283	Comoros	0.431
Yemen	0.404	Tanzania	0.311	SãoTomé and Príncipe	0.286	Botswana	0.443
Swaziland	0.412	Comoros	0.314	Lao	0.288	Pakistan	0.445
Cambodia	0.415	Lao	0.320	Tanzania	0.299	Rwanda	0.452
Mauritania	0.426	Afghanistan	0.326	Malawi	0.300	Yemen	0.454
Nigeria	0.428	Pakistan	0.326	Afghanistan	0.302	Gambia	0.456
Comoros	0.434	Bangladesh	0.351	Bangladesh	0.311	Swaziland	0.459

<b>South Africa</b>	0.434	Rwanda	0.358	Rwanda	0.345	Afghanistan	0.467
Gambia	0.451	Nigeria	0.376	Gambia	0.349	Lao	0.471
Bangladesh	0.462	Gambia	0.378	<b>Indonesia</b>	0.370	Cambodia	0.487
Lao	0.468	<b>Indonesia</b>	0.388	Botswana	0.372	Trinidad and Tobago	0.489
Senegal	0.476	Botswana	0.400	Uzbekistan	0.372	Bangladesh	0.502
Pakistan	0.493	Uzbekistan	0.400	Nigeria	0.375	<b>South Africa</b>	0.508
<b>Indonesia</b>	0.493	Tunisia	0.402	Egypt	0.384	Senegal	0.510
Tunisia	0.499	Vietnam	0.405	Tunisia	0.389	Uzbekistan	0.554
Afghanistan	0.501	Egypt	0.406	Vietnam	0.391	<b>Indonesia</b>	0.558
Bosnia and Herz	0.505	<b>South Africa</b>	0.411	Senegal	0.407	Egypt	0.576
Vietnam	0.507	Bosnia and Herz	0.422	Bosnia and Herz	0.411	<b>India</b>	0.576
Egypt	0.508	Senegal	0.424	<b>South Africa</b>	0.419	Vietnam	0.577
<b>Thailand</b>	0.513	Swaziland	0.430	<b>India</b>	0.422	Tunisia	0.584
UAE	0.516	UAE	0.435	St Vincent and the Grenadines	0.424	<b>Thailand</b>	0.600
Uzbekistan	0.520	<b>Thailand</b>	0.436	UAE	0.426	Bhutan	0.600
St Vincent and the Grenadines	0.538	Nicaragua	0.449	<b>Thailand</b>	0.427	Nepal	0.603
Samoa	0.544	St Vincent and the Grenadines	0.461	Myanmar	0.429	Bosnia and Herz	0.607
Jamaica	0.546	Bhutan	0.464	Bhutan	0.437	Nicaragua	0.611
Nicaragua	0.546	<b>India</b>	0.465	Samoa	0.439	Jamaica	0.612
Andorra	0.552	Jamaica	0.466	Nicaragua	0.439	St Vincent and the Grenadines	0.616
Armenia	0.558	Samoa	0.468	Nepal	0.443	UAE	0.618
Ecuador	0.561	Ecuador	0.468	Jamaica	0.443	Guatamala	0.619
Syria	0.568	Armenia	0.471	Ecuador	0.455	Myanmar	0.619
Bhutan	0.569	Guatamala	0.476	Algeria	0.461	Boliva	0.620
Portugal	0.570	Andorra	0.478	Guatamala	0.461	Ecuador	0.621
Bahrain	0.572	Nepal	0.480	Swaziland	0.462	Morocco	0.626
Guatamala	0.573	Boliva	0.496	Armenia	0.462	Samoa	0.626
Singapore	0.573	Portugal	0.497	Morocco	0.466	Dominican Republic	0.632
St Lucia	0.580	Syria	0.497	Boliva	0.468	Armenia	0.632
<b>India</b>	0.581	St Lucia	0.497	Syria	0.475	Algeria	0.641
Algeria	0.581	Morocco	0.497	Andorra	0.476	St Lucia	0.645
Brunei	0.583	Bahrain	0.501	Dominican Republic	0.478	Syria	0.650
Albania	0.584	Albania	0.501	St Lucia	0.481	Andorra	0.651
Nepal	0.587	Singapore	0.502	Portugal	0.495	El Salvador	0.654
Myanmar	0.587	El Salvador	0.509	Albania	0.495	Albania	0.655

<b>UK</b>	0.587	Algeria	0.511	El Salvador	0.497	Brazil	0.655
El Salvador	0.589	Brunei	0.513	Brazil	0.498	Belize	0.662
Brazil	0.592	Brazil	0.515	Bahrain	0.501	Portugal	0.662
Morocco	0.593	<b>UK</b>	0.517	Singapore	0.502	Venezuela	0.664
Boliva	0.600	Myanmar	0.518	Brunei	0.502	Kyrgyzstan	0.664
		Dominican					
Belize	0.600	Republic	0.524	Venezuela	0.512	Bahrain	0.667
Venezuela	0.603	Venezuela	0.527	<b>UK</b>	0.514	Singapore	0.668
Chile	0.604	Turkey	0.527	Belize	0.517	Brunei	0.668
Korea	0.607	Belize	0.528	Kyrgyzstan	0.520	Turkey	0.670
<b>China</b>	0.609	Chile	0.532	Turkey	0.523	Honduras	0.672
Turkey	0.610	Kyrgyzstan	0.535	Chile	0.524	<b>UK</b>	0.673
Dominican							
Republic	0.611	<b>China</b>	0.536	<b>China</b>	0.530	<b>China</b>	0.678
Kyrgyzstan	0.620	Korea	0.539	Honduras	0.530	Panama	0.678
St Kits and Nevis	0.621	Honduras	0.546	Panama	0.537	Chile	0.679
Honduras	0.626	Colombia	0.550	St Kits and Nevis	0.538	Colombia	0.682
Panama	0.626	Panama	0.551	Colombia	0.538	Azerbaijan	0.683
Colombia	0.627	Peru	0.552	Korea	0.539	Cape Verde	0.683
Peru	0.628	St Kits and Nevis	0.558	Peru	0.541	Peru	0.683
Malaysia	0.633	Mexico	0.562	Mauritius	0.550	Paraguay	0.686
Uruguay	0.634	Paraguay	0.567	Paraguay	0.551	Korea	0.691
Mexico	0.635	Cape Verde	0.567	Cape Verde	0.551	St Kits and Nevis	0.692
Sweden	0.636	Malaysia	0.567	Mexico	0.552	Mexico	0.693
Mauritius	0.637	Uruguay	0.568	Azerbaijan	0.557	Jordan	0.696
Bahamas	0.640	Sweden	0.574	Jordan	0.560	Uruguay	0.699
Paraguay	0.644	Mauritius	0.577	Uruguay	0.562	Mauritius	0.700
Luxembourg	0.647	Jordan	0.578	Malaysia	0.563	Malaysia	0.703
Cape Verde	0.647	Azerbaijan	0.586	Sweden	0.573	Bahamas	0.706
Barbados	0.651	Luxembourg	0.588	Barbados	0.574	Mongolia	0.707
Serbia	0.651	Serbia	0.589	Bahamas	0.578	Barbados	0.712
Jordan	0.652	Mongolia	0.597	Serbia	0.582	Sweden	0.715
Cuba	0.665	Barbados	0.598	Luxembourg	0.588	Serbia	0.718
Ukraine	0.665	Bahamas	0.599	Mongolia	0.591	Iran	0.722
Grenada	0.672	Ukraine	0.606	Iran	0.598	Ukraine	0.724
Azerbaijan	0.673	Cuba	0.610	Ukraine	0.598	Luxembourg	0.725
Argentina	0.674	Iran	0.613	Grenada	0.600	Grenada	0.733
Israel	0.676	Grenada	0.618	Argentina	0.601	Argentina	0.734
Mongolia	0.681	Israel	0.620	Cuba	0.605	Cuba	0.736
Iran	0.681	Argentina	0.620	Israel	0.617	<b>USA</b>	0.743
<b>USA</b>	0.682	<b>USA</b>	0.626	<b>USA</b>	0.622	Costa Rica	0.743
New Zeland	0.687	New Zeland	0.630	Costa Rica	0.623	Israel	0.744
Costa Rica	0.692	Costa Rica	0.634	New Zeland	0.627	New Zeland	0.748

Sri Lanka	0.702	Sri Lanka	0.645	Sri Lanka	0.637	Sri Lanka	0.753
Spain	0.704	Spain	0.654	Spain	0.651	Seychelles	0.763
Belgium	0.706	Belgium	0.655	Belgium	0.653	Spain	0.764
Slovenia	0.707	Slovenia	0.657	Hungary	0.653	Hungary	0.766
Hungary	0.711	Hungary	0.658	Slovenia	0.656	Belgium	0.767
Belarus	0.712	Belarus	0.664	Seychelles	0.657	Slovenia	0.770
Greece	0.717	Greece	0.668	Greece	0.663	Belarus	0.772
Montenegro	0.719	Montenegro	0.669	Belarus	0.664	Qatar	0.773
Switzerland	0.720	Qatar	0.670	Montenegro	0.665	Greece	0.774
Qatar	0.722	Seychelles	0.672	Qatar	0.666	Montenegro	0.774
Netherlands	0.723	Switzerland	0.672	Switzerland	0.668	Switzerland	0.776
Australia	0.726	Netherlands	0.675	Netherlands	0.672	Netherlands	0.780
Denmark	0.728	Australia	0.679	Australia	0.677	Bulgaria	0.781
Seychelles	0.729	Denmark	0.682	Denmark	0.678	Australia	0.783
Ireland	0.736	Bulgaria	0.688	Bulgaria	0.681	Denmark	0.784
Austria	0.738	Ireland	0.690	Ireland	0.688	Poland	0.790
Poland	0.739	Austria	0.692	Poland	0.688	Ireland	0.791
Bulgaria	0.741	Poland	0.692	Austria	0.690	Austria	0.792
Cyprus	0.744	Norway	0.701	Norway	0.699	Norway	0.799
Norway	0.744	Cyprus	0.701	Cyprus	0.700	Cyprus	0.800
Latvia	0.763	Latvia	0.717	Latvia	0.708	Latvia	0.801
Japan	0.765	Japan	0.725	Slovakia	0.719	Romania	0.806
Lithuania	0.769	Slovakia	0.726	Romania	0.719	Slovakia	0.809
Slovakia	0.769	Lithuania	0.727	Lithuania	0.725	Lithuania	0.814
Croatia	0.771	Romania	0.728	Japan	0.725	Japan	0.816
Romania	0.776	Croatia	0.731	Croatia	0.727	Croatia	0.817
Iceland	0.793	Iceland	0.758	Iceland	0.758	Estonia	0.837
Estonia	0.793	Estonia	0.765	Estonia	0.764	Iceland	0.839
Finland	0.801	Finland	0.767	Finland	0.766	Finland	0.844
Italy	0.804	Italy	0.771	Italy	0.769	Canada	0.844
Canada	0.809	Canada	0.774	Canada	0.769	Italy	0.844
France	0.820	France	0.788	France	0.785	France	0.855
Germany	0.828	Germany	0.798	Germany	0.796	Germany	0.862
Czech Republic	0.838	Czech Republic	0.810	Czech Republic	0.808	Czech Republic	0.871

Source: Authors own calculations

Looking at the overall WHI in figures 11, the best rated countries in the top 10 are Czech republic, Germany, France, Canada, Italy, Finland, Estonia, Iceland, Croatia, and Romania. From figure 14, the countries that are the bottom 10 in terms of overall health indicators are Angola, Mozambique, DRC, Chad, Cote d'Ivoire, Zambia, Burkina Faso, Sierra Leone, Burundi, and Niger. This WHI also would be tailored for use by WHO, World Bank and Gates Foundation for instance, or any organization focusing on overall health conditions.

The World Health Index, was calculated for all the countries the world where data is available. The WHI calculated from has a high correlation with the GNI per capita adjusted for DALYs.

The composition of the index can be customized to reflect the specific focus of an international funder or policy maker. The index can also be used to target special or vulnerable groups, by including indicators pertaining to those specific groups. The results for the tailored indices are in Annex D.

## Chapter 7: Country experiences at Subnational Level(India and Nigeria)

### 7.1 INDIA

We adapted our method to study health development within **India**, at the level of the State (subnational). Data on DALYs are not available at this level, and had to construct it using regression analysis.

We have at our disposal data on GNI per capita and poverty head count (for 17 States of India). Simple regressions with Indian data show that poverty head count is a best predictor of poor maternal health than GNI per capita estimates.

	(1) daly	(2) daly	(3) maternal	(4) maternal	(5) log_daly
gnipc	-0.175 (0.118)		-0.00196 (0.118)		
povhead		350.8** (0.012)		3.942** (0.012)	
log_gnipc					-0.362 (0.110)
Constant	24681.5*** (0.000)	8103.7** (0.049)	258.4*** (0.000)	72.08 (0.112)	13.50*** (0.000)
Observations	17	18	17	18	17
R-squared	0.155	0.336	0.155	0.336	0.161

p-values in parentheses

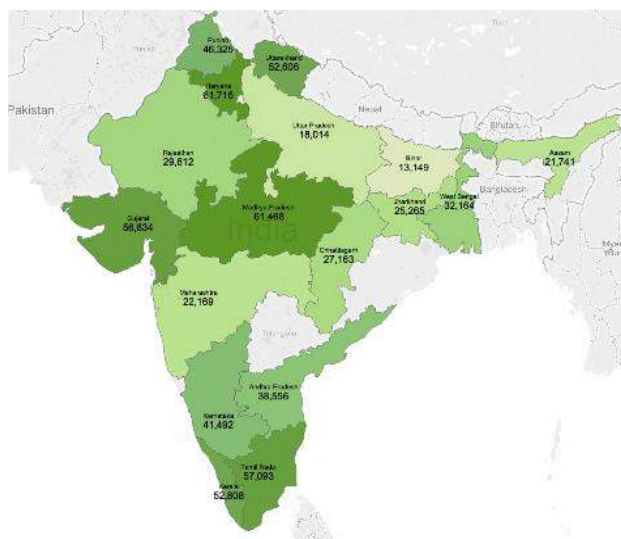
\* p<0.10, \*\* p<0.05, \*\*\* p<0.01

**Table 7: India: Regression results**

In figure 5 we show the geographic distribution of income and poverty in India. We then computed the DALYs for each state in India.

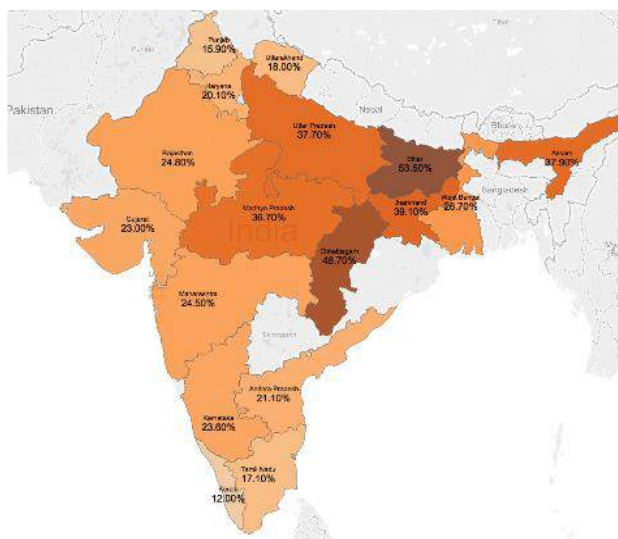
**Table : INDIA Subnational rankings**

**Income by State**  
Net Domestic Product per Capita (2013-14)



Published by the "Ministry of Statistics and Programme Implementation". 27 February 2015

**Poverty Headcount by State**  
Share of people living with less than 1.25\$ per day (2010)



Published by the World Bank – downloaded September 18<sup>th</sup> 2015  
Measured in PPP-adjusted 2005 international Dollar.

4

**Figure 5: India: geographic distribution of income and poverty**

Below, in table 7 shows the ranking of states in India using GNI per capita adjusted using DALY.

**Table 7: Rankings of States in India using GNI adjusted using DALYs.**

Region	GNI per capita	DALYs per person	Adjusted GNI per capita with DALY	Ranking based on GNI	Ranking based on DALY adjusted GNI	Reranking
Madhya Pradesh	69583.58147	0.2215701	54165.94036	1	5	-4
Haryana	67260.35124	0.14682102	57385.11787	2	1	1
Gujarat	63168.30306	0.12546414	55242.94624	3	3	0
Tamil Nadu	62361.45339	0.0969883	56313.12204	4	2	2
Uttarakhand	59160.89657	0.27674204	42788.58936	5	6	-1
Kerala	58961	0.07563142	54501.69585	6	4	2
Punjab	49411.20436	0.15482985	41760.875	7	7	0

Karnataka	45023.52265	0.14504128	38493.2533	8	8	0
Andhra Pradesh	42169.52969	0.1147857	37329.0707	9	9	0
West Bengal	36293	0.12101479	31901.01023	11	11	0
Rajasthan	31836.06625	0.24381685	24073.89686	12	12	0
Jharkhand	28882	0.21178153	22765.32585	13	13	0
Chhattisgarh	28372.62642	0.2215701	22086.10074	14	14	0
Maharashtra	24042	0.09431869	21774.39006	15	15	0
Assam	23392	0.30877736	16169.07999	16	16	0
Uttar Pradesh	19232.83953	0.27674204	13910.30429	17	17	0
Bihar	15506.40823	0.21178153	12222.43737	18	18	0
<b>India</b>	<b>39904</b>	<b>0.17529686</b>	<b>32908.9541</b>	<b>10</b>	<b>10</b>	<b>0</b>

From table 7 above, states like Madhya Pradesh drop in ranking when GNI per capita is adjusted using DALYS, and in this case drops for 1 to 5. States like Kerala, Tamil Nadu and Haryana improve their rankings slightly. The other states do not change rankings.

## 7. 2 NIGERIA

Nigeria is the most populous country in Africa in Africa, with a population of about 170 million people, and it has extremes in income distribution poverty distribution , health conditions. Using our methodology, we can see that (from Table 8) and figure X, poverty headcount and child mortality, are **worst in states** such as:

- Jigawa
- Gombe
- Sokoto
- Ebonyi
- Adamawa
- Bauchi
- Benue
- Yobe

The states with the least poverty and lower child mortality rates are:

- Lagos
- Niger
- Imo
- Anambra
- Osun
- Oyo

Clearly, the very worst states namely Jigawa, Gombe, and sokoto are in the orthen part of Nigeria, with the exception of Ebonyi in south of the country. The resources would have to allocated more towards these states with poor health outcomes and extreme poverty.

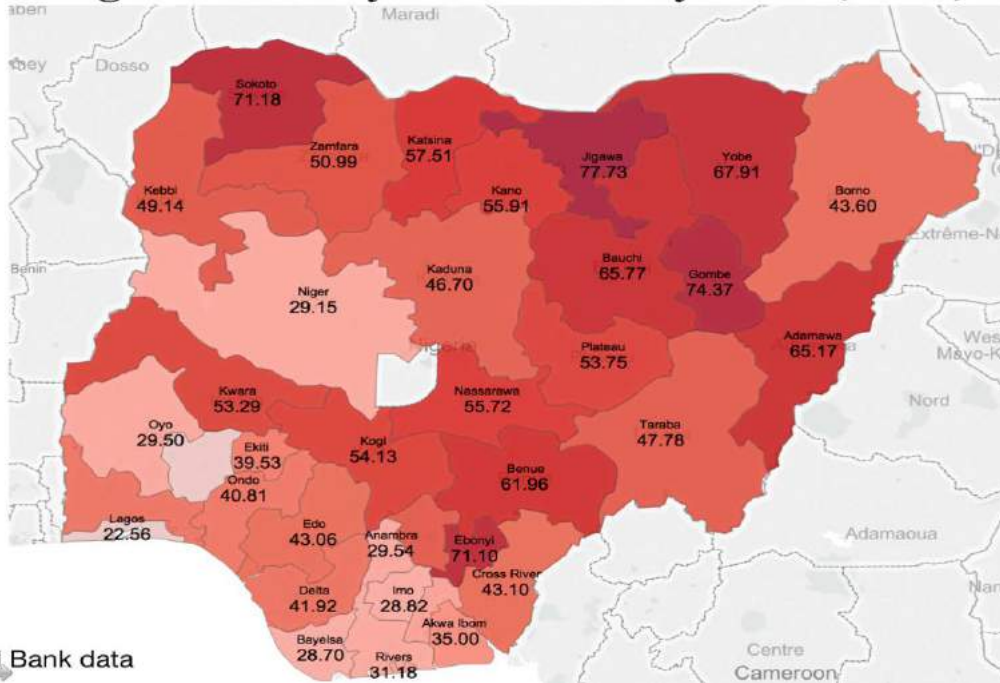
**Table 8: Nigeria: Poverty and Health distribution**



County(State)	Poverty headcount(2010)	Under-5 mortality (deaths per 1,000 live births)
Abia	31.13873	111
Adamawa	65.16787	127
Akwa Ibom	34.99797	117
Anambra	29.53582	93
Bauchi	65.77486	186
Bayelsa	28.70387	98
Benue	61.96109	116
Borno	43.59836	129
Cross River	43.09657	105
Delta	41.92335	99
Ebonyi	71.09906	123
Edo	43.05931	72
Ekiti	39.53231	90
Enugu	48.14022	111
Federal Capital Territory, Abuja	30.86045	102
Gombe	74.3692	146
Imo	28.82241	113
Jigawa	77.72562	182
Kaduna	46.69579	122
Kano	55.9065	154
Katsina	57.50839	170
Kebbi	49.14162	177
Kogi	54.12752	95
Kwara	53.29463	105
Lagos	22.5579	74
Nassarawa	55.71521	148
Niger	29.15358	111
Nigeria (country level)	46.0386	128
Ogun	41.34939	92
Ondo	40.81151	103
Osun	22.78741	99
Oyo	29.49671	74
Plateau	53.75257	143
Rivers	31.17728	96
Sokoto	71.18304	154
Taraba	47.77935	115
Yobe	67.90881	146
Zamfara	50.98568	209

Source: World Bank, POVCALNET,  
2015

## Nigeria: Poverty Headcount by State (2010)



15

**Figure 20: Nigeria: geographic distribution of poverty**

## Chapter 8: Some Country experiences regarding funding: Uganda and Swaziland

### 8.1: UGANDA

The new classification calls for adoption of the adjusted ranking system by policy makers and funders. There are interesting cases to note for the countries that drop to a lower rank with the new classification. For example, when the classification is adjusted for health inequality, Uganda drops a few places within the low rank, when compared to the simple GNI per capita ranking. Similarly, India drops in rank from lower middle income (LMIC) to low income (LIC). However, according to the current Global Fund eligibility criteria with respect to income, India does not qualify as a LMIC because its GNI per capita is above the cut-off mid-point for LMICs. For purposes of Global Fund policy, India is classified as an upper middle income country (UMIC). Additionally, Swaziland drops rank from LMIC to LIC under the new classification adjusted for health inequality and child mortality. Under the income criteria of the Global Fund, Swaziland new ranking would qualify it as a LMIC because its adjusted GNI per capita falls below the cut-off mid-point for UMICs.

The importance of re-ranking countries to qualify for DAH can be further understood by taking into account the importance of external resources in healthcare financing for some countries. Uganda and Swaziland are selected to illustrate this crucial point. Both Uganda and Swaziland DAH flow is typical of a developing country afflicted with high HIV prevalence rates so that the disease specific donor assistance is high.

**Table 9 Official Development Assistance to the Health sector in Uganda: Commitments 2004-2013**

	All Donors, Total (US \$, Millions)	DAC Countries, Total, as % of All Donors	Multilateral, Total, as % of All Donors	GAVI as % of All Donors	Global Fund as % of All Donors	Global Fund as % of Multilateral Total
2013	163.868	64.9	35.1	19.1	-	-
2012	290.235	31.4	68.6	4.2	21.0	30.7
2011	142.096	63.8	36.2	8.7	22.9	63.1
2010	222.367	38.5	61.5	3.8	-	-
2009	138.876	36.7	63.3	6.4	54.0	85.3
2008	202.281	52.6	47.4	8.8	26.0	54.8
2007	109.527	47.1	52.9	13.0	8.0	15.0
2006	52.123	61.3	38.7	-	-	-
2005	225.010	59.2	40.8	-	34.9	85.6
2004	63.668	44.8	55.2	-	53.4	96.8

Source: OECD Creditor Reporting System  
DAC=development assistance committee

In Uganda, the share of external resources for health in total expenditure on health has risen to more than two thirds since 1995.

**Table 10 Health expenditure shares in Uganda: 1995-2013**

	Total expenditure on health as a % of gross domestic product	General government expenditure on health as a % of total expenditure on health	Private expenditure on health as a % of total expenditure on health	General government expenditure on health as a % of total government expenditure	External resources for health as a % of total expenditure on health	Out-of-pocket expenditure as a % of private expenditure on health	Out-of-pocket expenditure as a % of total expenditure on health	Per capita total expenditure on health (PPP int. \$)	Per capita government expenditure on health (PPP int. \$)
2013	9.8	44.4	55.6	24.3	45.5	69.1	38.4	146	65
2012	9.8	43	57	24.2	46.7	69.1	39.4	141	61
2011	10.4	45.5	54.5	24.2	46.1	68.4	37.3	163	74
2010	12.3	48.6	51.4	32.6	49.6	64.9	33.4	167	81
2009	9.6	21.5	78.5	13.5	36.8	53.9	42.3	132	28
2008	10	25.3	74.7	16	34.4	57.8	43.2	134	34
2007	9.5	28.5	84.4	14.3	31.9	56.7	47.8	114	32
2006	8	33.9	101.3	15.1	27.7	55.3	56	90	30
2005	10.2	25.2	74.8	14.1	22.1	52.4	39.2	105	26
2004	9.7	25.5	74.5	12.1	24.5	48.2	36	84	21
2003	8.2	25.8	74.2	10.9	28.4	41.5	30.8	75	19
2002	8.5	27.1	72.9	11.1	27.9	44	32.1	73	20
2001	7.9	27.3	72.7	11.5	27.6	47.3	34.4	63	17
2000	7.2	27.1	72.9	8.8	27.4	51.8	37.7	56	15
1999	6.5	26.8	73.2	11.3	28.3	56.7	41.5	52	14
1998	6.5	30.6	69.4	13.7	27.5	61.5	42.7	47	14
1997	6.6	27.4	72.6	9.9	21.7	66.3	48.2	42	11
1996	6.9	25	75	9.9	14.4	66.3	49.7	42	10
1995	8.5	19.8	80.2	9.9	9.6	66.3	53.2	48	10

Source: WHO, Global Health Expenditure data base

Data in Table 10 shows that a big proportion of DAH is committed by the Global Fund and therefore goes to finance disease specific programmes, particularly HIV/AIDS. The Global Fund uses the World Bank Income classification to arrive at the minimum threshold required as counterpart funding for each country making an application for funds. Table 11 shows the current Global Fund counterpart funding levels for different country groupings. The minimum threshold requirement of 5% for Uganda, a low-income country category, translates into counterpart financing share of 54% for HIV and 50% for TB. Currently, the government funding towards HIV responses constitutes only 11% of the HIV National Strategic Plan (NSP) estimated expenditure requirements.

The new classification method ranks Uganda as a low income country even without adjusting for the mid-point average cut-off point to qualify as one. The question that arises is: should the Global Fund continue to use the 5% counterpart funding threshold for Uganda (and other countries with similar ranking)? The low level of funding share for HIV responses as laid out in the HIV NSP is an indication that Uganda is struggling to meet the minimum threshold for counterpart funding.

**Table 11: Global Fund, eligibility and Counterpart Funding**

Income category	Disease burden	Focus of application on specific populations and interventions	Counterpart financing
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LICs	No restriction	No restriction	5%
Lower LMICs	No restriction	50%	20%
Upper LMICs	No restriction	50%	40%
UMICs	Extreme, severe or high	100%	60%

The government of Uganda has put in place measures to mitigate the large dependency on external financing for health. The initiatives include the operationalization of the long pending National Health Insurance Scheme (NHIS). The AIDS Trust Fund is another plan that aims leverage domestic resources for the HIV interventions. The Fund proposes to raise additional resources from domestic sources through a tax on (a) direct incomes, (b) services and (c) manufactured goods.

## 8.2 SWAZILAND

The Global Fund is a major contributor to DAH for health in Swaziland as seen in Table 12. However, Swaziland government spending on health has been steadily increasing as seen in Table 13. The Global Fund requires that Swaziland meets the counterpart funding criteria as an upper-middle-income country at 40%. This translates to 76% for HIV and 43% for TB in order to meet the minimum threshold requirement. However, the new method has ranked Swaziland as a LMIC which qualifies for LIC if adjusted to the mid-point cut-off.

**Table 12: Official Development Assistance to the Health sector in Swaziland: Commitments 2004-2013**

	All Donors, Total (US \$, Millions)	DAC Countries, Total, as % of All Donors	Multilateral, Total, as % of All Donors	Global Fund as % of All Donors
2013	1.501521	40.3	59.7	
2012	10.036451	13.3	86.7	78.1
2011	1.068777	4.0	96.0	3.9
2010	23.449119	0.5	97.2	
2009	17.518693	1.0	99.0	98.7
2008	0.399681	41.0	59.0	
2007	1.752635	25.1	74.9	70.6
2006	1.052707	1.8	98.2	92.7
2005	0.137337	100		

Source: OECD Creditor Reporting System  
DAC=development assistance committee

**Table 13: Health expenditure shares in Swaziland: 1995-2013**

	Total expenditure on health as a % of gross domestic product	General government expenditure on health as a % of total expenditure on health	Private expenditure on health as a % of total expenditure on health	General government expenditure on health as a % of total government expenditure	External resources for health as a % of total expenditure on health	Out-of-pocket expenditure as a % of private expenditure on health	Out-of-pocket expenditure as a % of total expenditure on health	Per capita total expenditure on health (PPP int. \$)	Per capita government expenditure on health (PPP int. \$)
2013	8.4	74.7	25.3	18.1	16.6	42	10.6	564	421
2012	8.1	72.6	27.4	18.1	21.5	42.2	11.5	524	380
2011	8	68.8	31.2	18.1	19.8	42.8	13.4	508	349
2010	8	68	32	15.4	13.8	43	13.8	508	345
2009	8.5	68	32	14.3	8.4	43.3	13.8	534	363
2008	8.2	69.6	30.4	14.5	7.4	42.8	13	514	358
2007	7	68.3	31.7	12.5	6.4	42.2	13.4	431	295
2006	6.8	66.9	33.1	14.9	10.9	42.3	14	398	266
2005	6.8	67.5	32.5	13	3	42.2	13.7	378	255
2004	5.9	63.3	36.7	10.5	7	42	15.4	312	197
2003	5.7	65.2	34.8	12.3	2.2	41.5	14.4	288	188
2002	5.2	59.2	40.8	9.9	1.9	41.9	17.1	251	148
2001	5.1	57.4	42.6	10	1.8	42.1	17.9	242	139

## Chapter 9: Conclusions

The new health classification approach proposal above, for classifying countries around the world, does not only reflect the income status of a country, but also access to health and quality of health services. The New Classification methodology has been tested and shows some dramatic results for some countries, in terms of re-classification. It has much potential for significant impact for policy makers and decision makers in these countries and for citizens in these countries whose lives and well-being might otherwise be at risk of losing resources prematurely.

A new measure has to be simple to understand, replicable and easy to compute, representative of the issues it is meant to capture, make use of universally acceptable inputs, and also be grounded in theoretical principles of socio-economic well-being. Our approach seeks a more nuanced measure of incomes and ability to pay for health, as measured by, Gross National Income (GNI) per capita. In this regard our approach will take into account, i) countries' ability to domestically finance health as measured by GNI per capita; and ii) countries' health system capacity and efficiency in delivering health services and interventions.

Our approach posits that inequality is a good indicator of inequality in health access. In low-income countries, inequality is also strongly linked to spatial inequality between rural and urban areas, with the poor living mainly in rural areas. Therefore, inequality measures also reflect the spatial divide between rural areas, which typically have low health access levels, and urban areas with a higher level of health access.

Our results are robust for different inequality and poverty measures and adjustment mechanisms. We also propose a continuous scale measure rather than a discrete country classification ordering. Our approach also works well at the subnational level, as illustrated by the cases for India and Nigeria.

## Chapter 10. Recommendations

The recommendations that flow from our approach are as follows:

1. Make use of DALY- adjusted GNI per capita, and general poverty-adjusted GNI per capita, in determining medium-term capacity to finance health and in capturing access to health
2. DALYs, as an outcome, strongly reflect disease burden and the quality of health and health inequality, thereof.
3. The World Health Index components should be used as a dashboard. The WHI captures quality of health systems and health development path. Also use a tailored WHI to bias it towards the needs of each global health institution
4. A continuous scale should be used in ranking countries in respect of health financing capacity and health access
5. Make use of the new framework at subnational level and in targeting vulnerable regions or specific key populations



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## Annex

### Annex A: Sustainable Development Goals on Health

Sustainable Development Goals(SDGs) were launched and adopted in September 2015 by the UN, which has set the global development agenda for the next 15 years. The health sector development priorities are captured in SDG 3. **SDG3 states that: ‘Ensure healthy lives and promote well-being for all at all ages’.** The targets for the SDG3 are:

1. By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births
2. By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births
3. By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases
4. By 2030, reduce by one-third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being
5. Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol
6. By 2020, halve the number of global deaths and injuries from road traffic accidents
7. By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes
8. Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all
9. By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination
10. Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate
11. Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all
12. Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States
13. Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks

If we can just focus on target 3, for example, regarding HIV, which aims to “end the HIV epidemic by 2030”. At the end of 2013, 35 million people were living with HIV. That same year, some 2.1 million people became newly infected. Close to 12 million people in low- and middle-income countries were receiving antiretroviral

therapy, at the end of 2013. More than two-thirds of new HIV infections are in sub-Saharan Africa. While 15 million people are currently on treatment worldwide, less than half those eligible to receive drugs are not accessing them. Most are in sub-Saharan Africa. A massive scale-up in funding may be required, and prevention efforts need to be boosted for an epidemic which still has no vaccine. Populations at risk also need to be targeted.

It is worth noting that the disease has mutated from a mere emergency to a long-term financial liability for high prevalence countries, from both treatment and prevention perspectives. As a chronic disease, the cost of keeping people currently on treatment alive for the duration of their life in sub-Saharan Africa alone is over US\$ 300 billion (see Collier, Sterck, and Manning (2015)). Collier et al (2015) argue that this hidden liability is about 13% of GDP in Kenya, for example, if one projects 35 years into the future, beyond 2030. This is a substantial hidden cost that would need to be funded by both affected countries and the international community.

Some of the countries in Africa, for example, with poor health conditions, that were hopeful of tapping into revenues from natural resources, have experienced a collapse in commodity prices, especially oil, copper and nickel. It is not surprising that Nigeria and Zambia are experiencing major macroeconomic challenges with rising budget deficits, falling currency reserves, exchange rate volatility, and rising debt levels. The domestic environment for financing health needs, and SDG targets in general, will prove to be difficult for some countries. However, there is still room to innovate, especially in areas such as introducing National Health Insurance schemes, mobile telephony usage charges, debt guarantees from international financial institutions, and plain-vanilla taxation effort, *inter alia*.

Research by Kabajulizi and Ncube (2015) shows that there are hidden, but substantial economic benefits from intervening on HIV. Using Uganda as a case study, they analyse the channels of transmission of the impact of financial resources, through (i) the human resource channel and, (ii) the source of fiscal space for HIV/AIDS channel. They show that if the government intervenes by scaling up treatment and prevention of HIV, the negative economic impacts of HIV/AIDS – including the soaring cost of production due to rising wages, declining GDP growth rates relative to the base, and the rising domestic debt as share of GDP – are reversed. The economy grows from a growing labour force supply and resource flows to HIV interventions. The study demonstrates that low-income-countries (LICs) like Uganda have the capacity to mobilise domestic resources to fund HIV interventions by increasing revenues from direct taxes.

Clearly, financing access to health is at the core of both the domestic and global development agenda.

## Annex B: Health Poverty and Health Inequality

McIntyre and Meheus (2014) establish a target for universal primary healthcare spending by summing costs of a set of key basic healthcare services for low-income countries. The authors follow the list of the High-level Taskforce on Innovative International Financing for Health Systems (2009), which consists of a limited set of services related to mainly communicable diseases including ATM and child and maternal care.<sup>2</sup> The costs for this basket of services – if it were to be delivered efficiently – is estimated to be 86 dollar per capita per year (in 2012 dollar). McIntyre and Meheus (2014) state that 5% of GDP is a minimum spending level for healthcare services. This implies that a total income of  $(86 \text{ dollar} / 5\%) / 365.24 \text{ days per year} = 4.71$  dollar per day is a theoretical minimum income budget which includes a 5% budget for basic healthcare services. We use this number as our poverty line.

In the figure B1 below we show the income level and distribution of a country, where the population is normalized to 1 and ordered on the basis of their income on the x-axis. On the y-axis we display daily per capita income of individuals. We have drawn the graph as a straight line but it may be curved, and the straight line is merely an illustration. The top horizontal line,  $y$ , shows mean income per capita or GNI per capita; the second horizontal line is the healthcare poverty line of \$4.71. In the illustration below we assume that in this country mean income lies above the poverty line – this is not necessarily the case. The entire income of a country consists of  $A + C$ , which is equal to GNI per capita due to our normalization of the population to 1. Here,  $A$  is the part of income above the \$4.71 and therefore indicates a surplus that is theoretically available to fund healthcare for other citizens.  $B$  is our measure of the poverty gap, showing the part of income that is missing in the short run within a country to fund healthcare, or the mean shortfall of income as a proportion of the poverty line. The size of  $B$  depends on both the share of individuals with an income below \$4.71, and the extent to which their income is below \$4.71. In the short run, without any additional external funding,  $B$  shows the lack of funding leading to suboptimal health consumption.

The ratio  $Z = A/B$ , measures how many times (or how easily) a country could lift people above the healthcare poverty line. This can be seen as a long-run indicator: the extent to which a country can lift its citizens out of suboptimal health consumption after (theoretical) redistribution. If this is higher, than a country is richer and access to healthcare is more widespread. Since,

$$(B1) \quad A + C = \text{GNI per capita per day}$$

$$(B2) \quad C = \$4.71 - B$$

then

$$(B3) \quad A = \text{GNI per capita per day} - \$4.71 + B$$

Expression (14) gives **health poverty-adjusted GNI per capita per day**, which can be converted to an annualized figure by multiplying by 365. We use this to rewrite the index  $Z$  as,

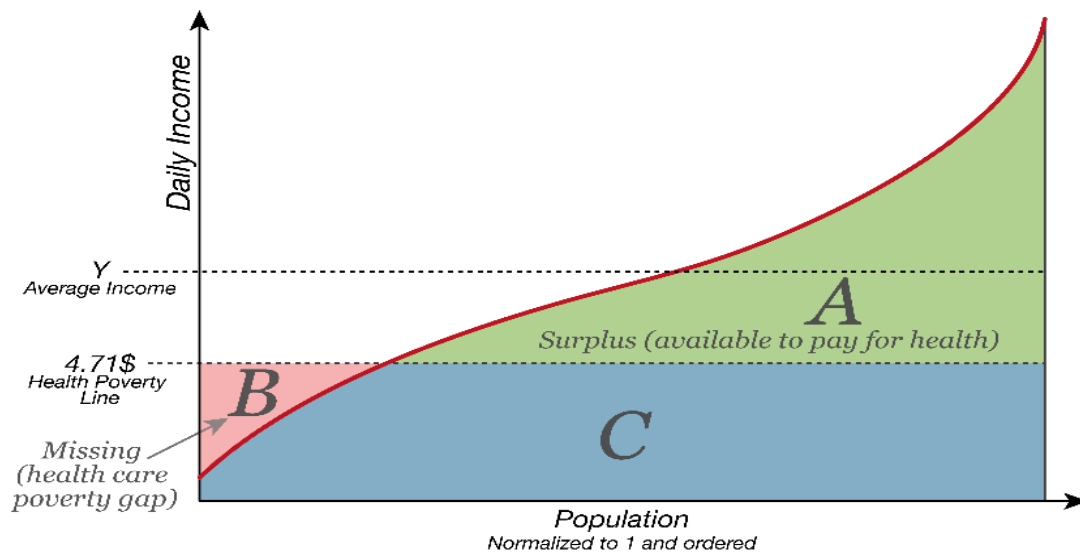
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<sup>2</sup> It includes AIDS, TB, malaria, immunizations, acute respiratory infections, diarrheal diseases, maternal and perinatal conditions and malnutrition, and a small number of interventions for chronic diseases, and essential drugs for some cancers, tropical diseases, mental health and general care.

**(B4)**  $Z = A/B = (\text{GNI per capita per day} - \$4.71 + B)/B = (\text{GNI per capita per day} - \$4.71)/B + 1$

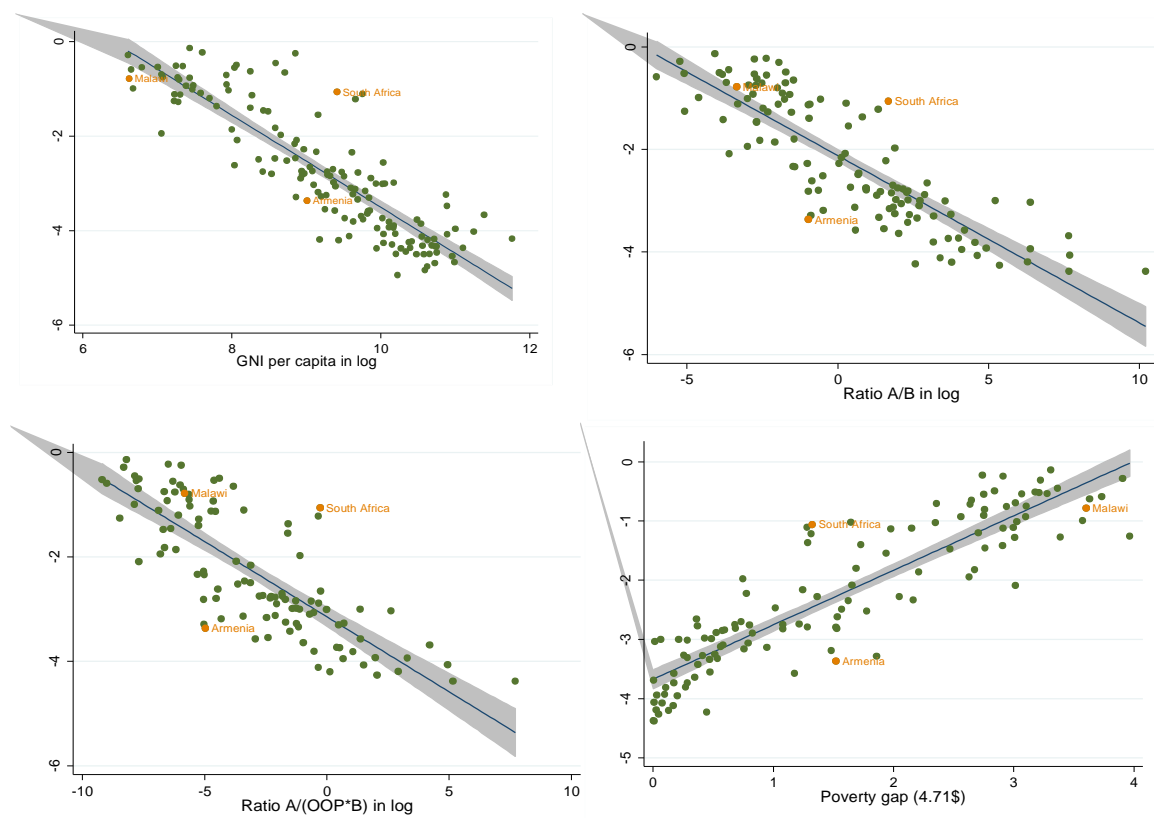
We can now look at different scenarios.

- Assume a country where A and B are non-zero. Then, the final outcome measure will be increasing in the level of funding availability (A) and decreasing in the level of lack of funding (B).
- Assume a poor country, where every citizen has an income below the healthcare poverty line. In this case, A is zero and B is positive implying that the ratio is equal to 0.
- Assume a rich country, where every citizen has an income above the healthcare poverty line. In this case, the ratio is undefined (infinite).



*Figure B1: poverty gap and surplus to finance health care*





**Figure B2: Correlation between DALYs and GNI per capita, ratio of A/Out-of-pocket expenses\*B., and with poverty gap.**

	(1)	(2)	(3)	(4)
	log_dal~m	log_dal~m	log_dal~m	log_dal~m
log_gnipc	-0.975*** (0.000)			
log_AdivB		-0.319*** (0.000)		
log_AdivB2			-0.287*** (0.000)	
povgap471				0.913*** (0.000)
Constant	6.269*** (0.000)	-2.120*** (0.000)	-3.129*** (0.000)	-3.675*** (0.000)
Observations	105	105	105	105
R-squared	0.665	0.719	0.652	0.801

p-values in parentheses  
\* p<0.10, \*\* p<0.05, \*\*\* p<0.01

**Table B1: Regressions and correlations DALYs vs GNI per capita, log(A/B), poverty gap, and poverty gap adjusted for out-of-pocket expenses**

From figure B2 and regressions in table B1 above, we see that the DALYs are negatively correlated with GNI per capita(in log terms). As income increases, the DALYs reduce. As the ability of countries to lift their health poor above the threshold of 4.71, the DALYs reduce. However, the poverty gap increases, the DALYs also increase. Finally, if we adjust the poverty gap with the out-of-pocket expenses, then the correlation with new ration of A to adjusted B with DALY is negative. The correlations are consistent with expectations.

### Health Poverty adjusted Measure

GNI per capita and the poverty gap can be conceptualized as inputs (among other variables) in a process that produces DALY per capita in each country. In Figure 1 we saw that the relationship between inputs and outcomes is likely to be logarithmic: the number of DALYs lost per capita is a sharply decreasing function of income per capita in poor countries, but is almost flat when GNI per capita exceeds a certain threshold.

In Figure B3, we represent the relationship between ln(DALYs) and ln(A/B). A regression line with the confidence interval is represented. It confirms that the relationship between DALYs lost and the ratio A/B is well represented by a log-log functional form. The R<sup>2</sup> of this log-log regression is equal to 0.71.

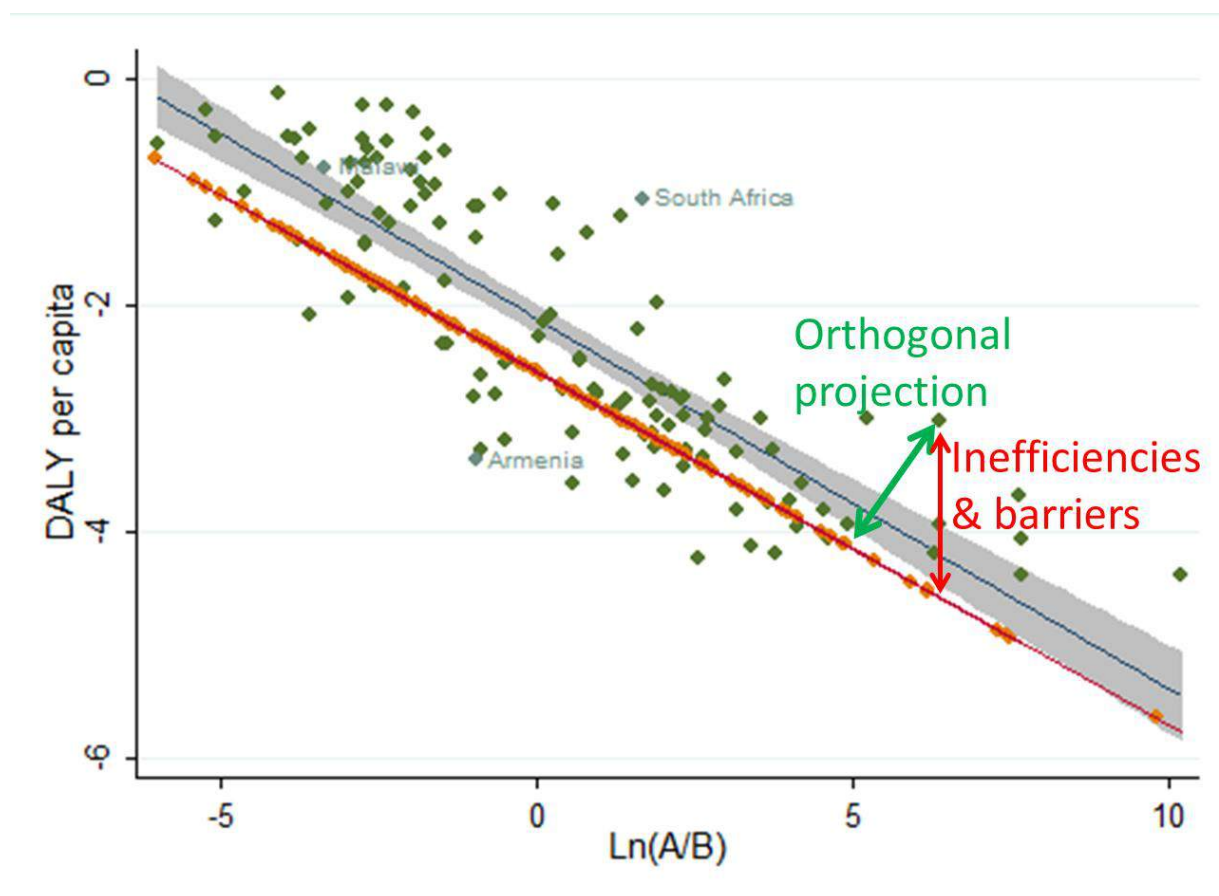


Figure B3 – The linear relationship between  $\ln(\text{DALY})$  and  $\ln(A/B)$

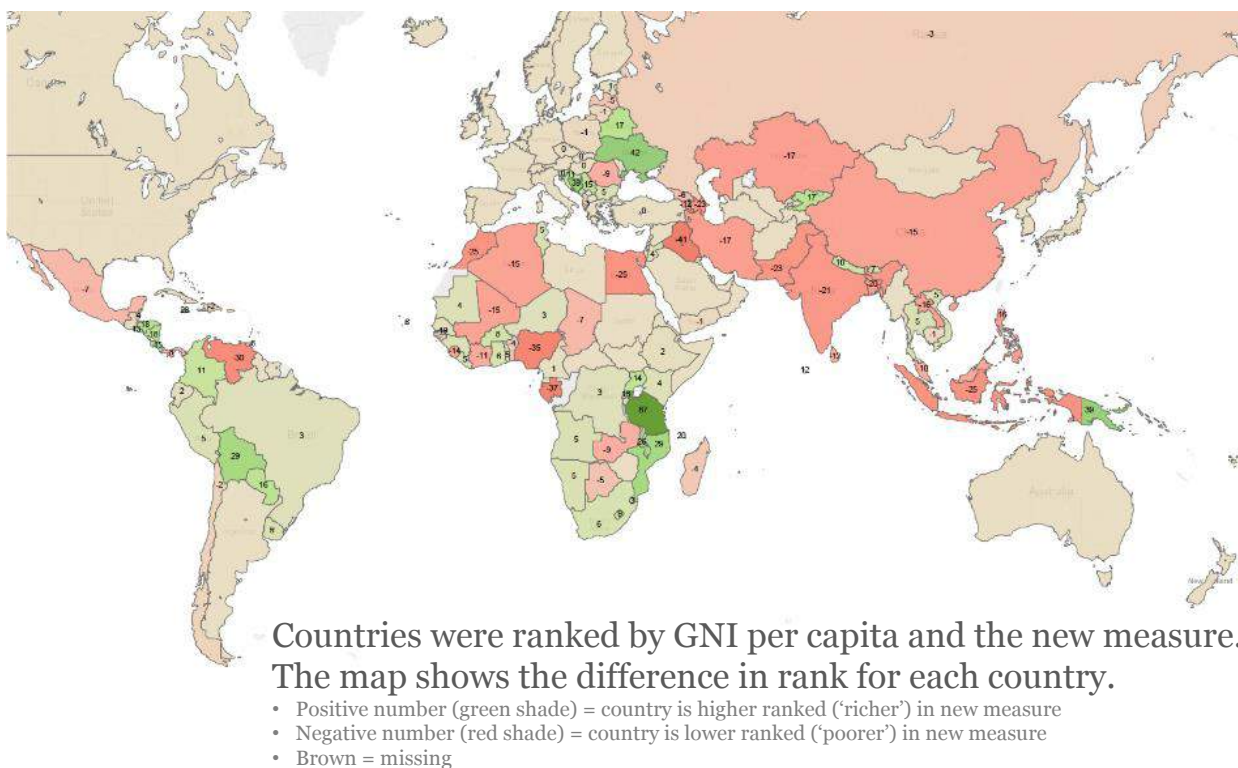
However, our main interest does not lie in measuring the average behavior of countries. Instead, we would like to capture the best outcome that countries could reach given the countries' financial means. To do so, several methods are possible. It is possible to draw insights from the principles of efficiency analysis. On the x-axis, countries with the lower ability to pay for healthcare are represented on the left and those with higher ability to pay on the right. For a given ability to pay, i.e. for any level of the log ratio  $A/B$  indicator, countries with lower DALY per capita can be thought as more efficient, everything else being the same, then countries with higher DALY per capita. It would hence be possible to draw an efficiency frontier joining the data points of the most efficient countries, for any given level of ability to pay. This is in figure 5. Data Envelopment Analysis (DEA) could be used to estimate the health production frontier. However, DEA is sensitive to outlying observations.

Because we are aware of measurement error, we do not use the minimum but rather look at the first quartile using quartile regression to estimate a reasonable path of health development. We call this quartile regression line the "health development path".

Any deviation from this line for given financial means indicates the presence of barriers or inefficiencies in health. These barriers or inefficiencies can come from different sources: lack of political will, vulnerability to specific drivers, or for instance a lack of past investment in health.

Our objective is to derive a single scalar combining the input-outcomes into a unique number that allows the ranking of countries along the health development path. To do so, we calculate the orthogonal projection of the situation of countries on the health development path. For each country, this **projection and ‘distance-to-frontier(DTF)’**, is the closest point on the health development path. **Countries can then be ranked according to the position of this projection on the health development line.**

The results are presented in Tables B4a and B4b and figure B4, below. For the sake of comparison, this table only reports the ranking of countries for which data is available for all variables used in the exercise. It shows that the ranking of countries is changed when the new approach is taken into account. As an example, while Gabon ranks 20<sup>th</sup> according to its GNI per capita (atlas method), it ranks 57<sup>th</sup> according to the new indicator because of high inequality and the poor quality of the health system in Gabon. This is a consequence of Gabon’s high poverty gap (0.27) and inefficiency indicator. In contrast, poverty is relatively low in Montenegro and the healthcare system is efficient, implying that Montenegro re-ranks from the 29<sup>th</sup> position in terms of GNI per capita to the 18<sup>th</sup> position in terms of its position on the health development path.



3

**Figure B4: Re-ranking of Countries(relative to GNI per capita)**

Looking at table B4a, the **10 most efficient countries** (in the sample) in delivering health relative to their ability to take the population above the health poverty line are:

- Armenia,
- Georgia,

- Macedonia,
- China,
- Sri Lanka,
- Bangladesh,
- Egypt,
- Albania,
- Montenegro,
- Serbia.

The **10 least efficient countries** are:

- Papua New guinea,
- Swaziland,
- Angola,
- Ukraine,
- Lesotho,
- Gabon,
- Chad,
- CAR,
- Botswana,
- South Africa.

From table B4a, **the top ranked countries**(in the sample) in terms of their development path are:

- Croatia
- Czech republic
- Belarus
- Slovakia
- Bosnia
- Ukraine
- Hungary
- Russia,
- Estonia.

On the other hand, the **bottom ranked countries** in terms of the development path are:

- Nigeria
- Guinea
- Niger
- Guinea-Bissau
- Sierra Leone
- Liberia,
- Madagascar
- Mali
- Congo, Dem Republic
- Burundi

In Table B4b, we show results using the usual **poverty line of \$1.25** and compare the rankings with the **health poverty line of \$4.71**. As show on table 5b, the ranking between countries are relatively similar when considering either the \$1.25 poverty line or the \$4.71 health poverty line. The correlation between the

rankings is 0.89. However, we argue that the health poverty line should be used because, by construction, it is the poverty line that better reflects the ability to pay for health care of individuals in the short run.

The correlation between the DALY-adjusted GNI per capita, given by  $\text{GNI per capita} \times (1 - \text{DALY rate lost})$  and the health poverty gap is high at -84.86%. This shows that the health poverty gap captures the disease burden that DALYs also capture. The results are consistent. This is also confirmed by the ranking of countries, where the countries that are at the bottom of the list are a similar group of countries with only minor variation, regardless of the method one uses.

### **Taking out-of-pocket expenditures into account**

One further adjustment can be made to our indicator to take into account for the fact that healthcare might be provided in-kind, which would not be reflected in the per capita income information. We correct for this by multiplying B by the percentage of out-of-pocket payments of total funding as shown in table 1. A much larger share of total healthcare spending is funded through out-of-pocket spending in low and lower-middle income countries compared to high income countries (46.5-54.7 compared to 15.3 per cent), whilst total healthcare spending as a percentage of GDP is lower (4.2-5.3 per cent compared to 12.0 per cent).

Perhaps surprisingly, the correlation between DALYs lost and our indicator is slightly lower when OOP expenditures are taken into account ( $R^2 = 0.64$  instead of 0.71) (see figure 3). The new ranking when OOP expenditures are taken into account is shown in Table 2. The example of Azerbaijan shows that countries with high OOP expenditures re-rank downward from rank 33 to rank 45 when OOP expenditures are taken into account. On the contrary, Lesotho re-ranks upward from the 77<sup>th</sup> to the 67 position because of its relatively low OOP expenditures (14.4%). The counterintuitive results might be explained by the fact that OOP might be regressive, in particular in rural areas where poverty is very high and access to healthcare is low. There is empirical evidence that user fees decrease health consumption, in particular by the poor (Jacobs & Price, 2004; Burnham *et al.*, 2004; McIntyre *et al.*, 2006). There is strong evidence that richer citizens are found to benefit relatively more of public spending on health in developing countries (Castrileal, 2000; Maniken *et al.*, 2000; Gwatkin *et al.*, 2005; Kruk *et al.*, 2008). This transmits to a large discrepancy between the use of healthcare services between the bottom and top quintile within countries (Peters *et al.*, 2008).



## Annex C: Trends in Maternal Mortality, Child Mortality and Selected Diseases

### 1. Maternal mortality

The maternal mortality ratio (MMR), defined as the annual number of female deaths from any cause related to or aggravated by pregnancy or its management (excluding accidental or incidental causes) during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, per 100,000 live births, for a specified year, is significant for developing countries. The MMR indicator reflects the capacity of the health systems to provide effective health care in preventing and addressing the complications occurring during pregnancy and childbirth. Table 2 reveals that over 40 of the 50 top ranked countries with highest MMR in 2013 are African countries.

Maternal conditions rank very high in causing female deaths in developing countries. Complications during pregnancy and childbirth are a leading cause of death and disability among women of reproductive age particularly in low- and lower middle-income countries. Data in Table 1 reveals that maternal conditions were among the top 5 causes of death among females aged 15-59 years in low-income countries in 2000 and persistently remained high among the causes of death more than a decade later.

Table C1 Causes of death among females aged 15 - 59 years by World Bank income groups

		Year	Cause of death rank	Year	Cause of death rank
Income group		2000		2012	
High income	All Causes	635,830		614,858	
	Maternal conditions	2,670	63	2,682	61
Upper middle income	All Causes	1,456,766		1,512,650	
	Maternal conditions	32,657	24	22,023	35
Lower middle income	All Causes	2,287,827		2,429,271	
	Maternal conditions	214,203	7	143,944	11
Low income	All Causes	1,216,600		1,093,375	
	Maternal conditions	177,687	5	127,294	6

Source: WHO data observatory



Table C2: Maternal mortality ratio for the top 50 countries ranked by 2013 figures

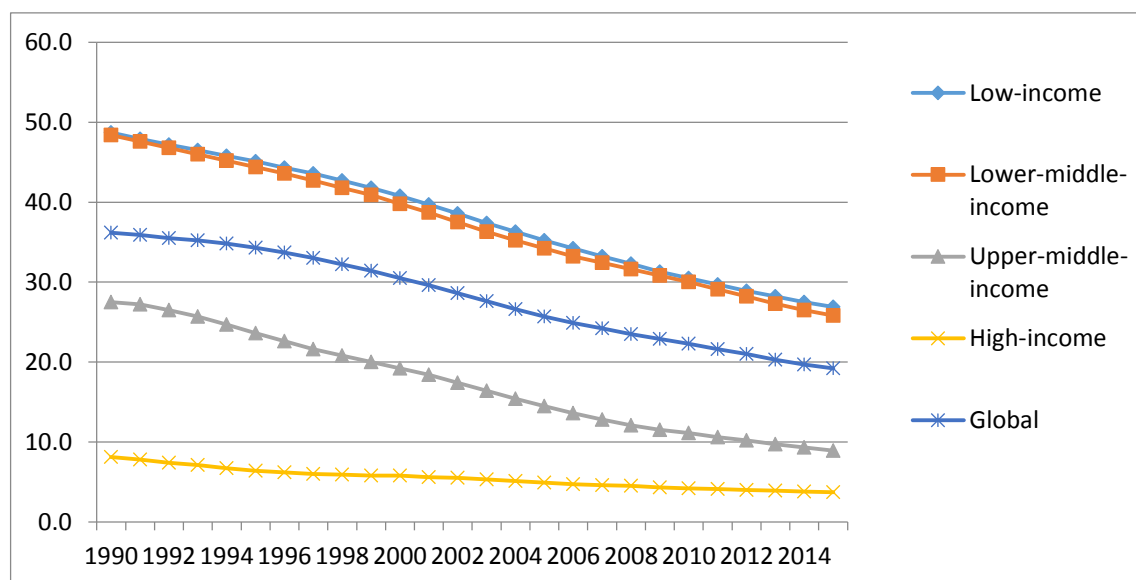
	2013	2010	2005	2000	1995	1990
1 Sierra Leone	1100	1200	1600	2200	2400	2300
2 Chad	980	1100	1200	1500	1600	1700
3 Central African Republic	880	960	1100	1200	1200	1200
4 Somalia	850	930	1100	1200	1300	1300
5 Burundi	740	820	910	1000	1300	1300
6 Democratic Republic of the Congo	730	810	930	1100	1100	1000
7 South Sudan	730	830	1000	1200	1500	1800
8 Côte d'Ivoire	720	750	750	670	710	740
9 Guinea	650	690	800	950	1000	1100
10 Liberia	640	680	880	1100	1600	1200
11 Niger	630	690	760	850	920	1000
12 Cameroon	590	640	690	740	760	720
13 Guinea-Bissau	560	600	760	840	790	930
14 Nigeria	560	610	740	950	1100	1200
15 Mali	550	600	710	860	1000	1100
16 Malawi	510	540	570	750	870	1100
17 Lesotho	490	540	670	680	630	720
18 Mozambique	480	540	680	870	1100	1300
19 Zimbabwe	470	610	740	680	550	520
20 Angola	460	530	750	1100	1400	1400
21 Togo	450	480	510	580	660	660
22 Madagascar	440	480	530	550	640	740
23 Gambia	430	460	510	580	660	710
24 Ethiopia	420	500	740	990	1200	1400
25 Congo	410	450	530	610	650	670
26 United Republic of Tanzania	410	460	610	770	890	910
27 Afghanistan	400	500	730	1100	1200	1200
28 Burkina Faso	400	440	500	580	680	770
29 Kenya	400	460	550	570	530	490
30 Eritrea	380	450	530	670	1000	1700
31 Ghana	380	410	470	570	650	760
32 Haiti	380	420	470	510	580	670
33 Sudan	360	390	460	540	640	720
34 Uganda	360	410	510	650	740	780
35 Comoros	350	380	430	480	560	630
36 Benin	340	370	420	490	520	600
37 Mauritania	320	360	400	480	550	630
38 Rwanda	320	390	610	1000	1400	1400
39 Senegal	320	360	420	480	510	530
40 Swaziland	310	350	480	520	480	550
41 Equatorial Guinea	290	330	480	790	1300	1600
42 Zambia	280	320	430	610	630	580
43 Timor-Leste	270	330	500	680	1000	1200
44 Yemen	270	290	330	370	420	460
45 Guyana	250	230	240	240	230	210
46 Gabon	240	260	300	330	340	380
47 Djibouti	230	250	310	360	390	400
48 Lao People's Democratic Republic	220	270	410	600	830	1100
49 Papua New Guinea	220	240	280	340	370	470
50 Sao Tome and Principe	210	230	260	300	360	410

Source: WHO data observatory

## 2. Neonatal mortality

Mortality during the neonatal period accounts for a large proportion of child deaths, and is considered to be a useful indicator of maternal and new-born neonatal health and care (WHO 2015). Neonatal mortality rate is defined by the WHO as the number of deaths during the first 28 completed days of life per 1000 live births in a given year or other period. From Figure 1, we observe a declining trend in neonatal mortality for all categories of country groups classified by income. Although the trend shows a decline for all categories of income classifications, the low-income and lower-middle-income countries still bear the burden of high neonatal mortality compared to the global average.

Figure C3: Trend in neonatal mortality: 1990 - 2015



Some countries within the low-income and lower-middle income have made greater improvements in reducing neonatal mortality when compared to others (see examples in Table 4).

Table C4: Neonatal mortality for selected countries: 2015 and 1990

	1990	2015	change
India	57.4	27.7	52%
Mali	73.1	37.8	48%
Mauritania	45.9	35.7	22%
Morocco	36.5	17.6	52%
Mozambique	61.5	27.1	56%
Nepal	58.5	22.2	62%
Nigeria	50.4	34.3	32%

Rwanda	40.8	18.7	54%
Sierra Leon	53.9	34.9	35%
Uganda	38.5	18.7	51%

Source: WHO data observatory

### 3. HIV and AIDS

Sub-Saharan Africa has the highest HIV prevalence rate. Table 5 shows the prevalence rate in selected African countries for females and males as well as by residence (rural/urban). The prevalence rate is defined by the WHO as the estimated number of people living with HIV, whether or not they have developed symptoms of AIDS, divided by the total population.

Table C5: HIV prevalence in selected Sub-Saharan Africa countries

	Year	Rural		Urban	
		Female	Male	Female	Male
Benin	2006	1.0	0.7	2.8	0.5
Burkina Faso	2010	0.7	0.5	2.6	1.4
Burundi	2010	1.2	0.7	6.1	2.4
Côte d'Ivoire	2005	5.5	2.5	7.4	3.2
Cabo Verde	2005	0.4	0.7	0.4	1.4
Cameroon	2011	4.6	2.7	6.4	3.0
Central African Republic	2010	3.7	1.9	10.3	4.8
Congo	2009	3.3	2.3	4.6	1.9
Democratic Republic of the Congo	2007	1.0	0.6	2.4	1.3
Ethiopia	2011	0.8	0.5	5.2	2.9
Ghana	2003	2.5	1.4	2.9	1.5
Guinea	2005	0.9	1.1	3.9	0.6
Lesotho	2009	25	17	31	21
Liberia	2007	1.1	0.6	2.8	2.1
Malawi	2010	10.5	7.1	22.7	12
Mali	2006	1.2	0.6	2.3	1.5
Mozambique	2009	10.7	7.2	18.4	12.8
Niger	2006	0.5	0.6	1.5	1.3
Rwanda	2010	2.8	1.6	8.7	5.4
Senegal	2010-2011	0.7	0.6	0.9	0.3
Sierra Leone	2008	1.2	0.6	2.7	2.2
Swaziland	2006-2007	29	17	37	26
Uganda	2011	7.7	6.1	10.7	6.1
Tanzania	2011-2012	5.2	3.4	8.9	5.1
Zambia	2007	11	9.4	23.1	15.9
Zimbabwe	2010-2011	17	12	20	13

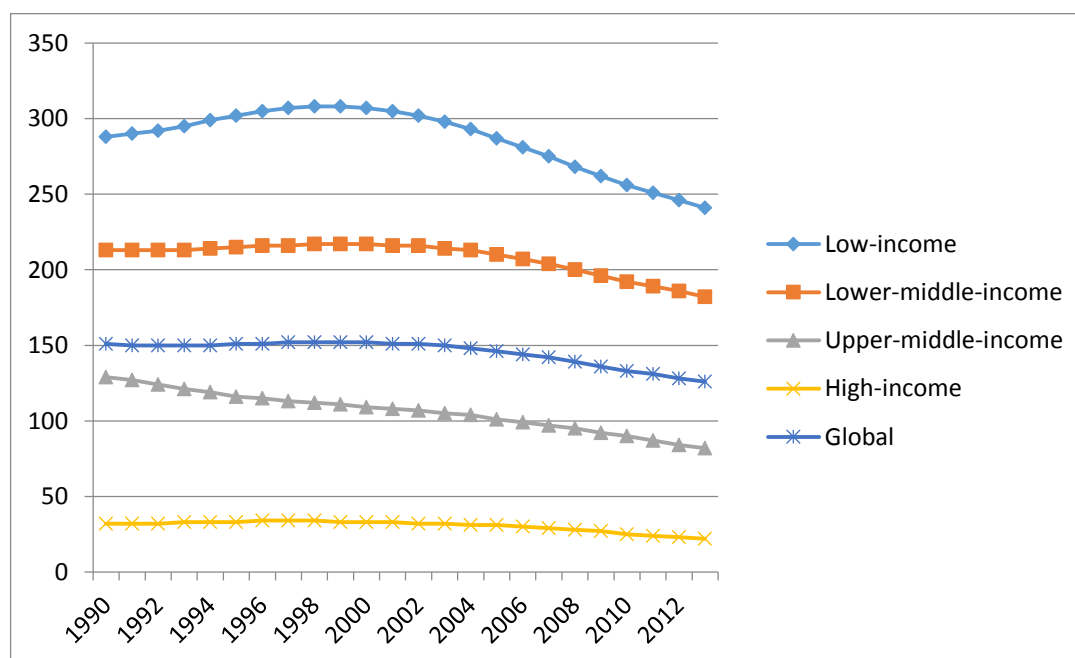
Source: WHO data observatory

In all the countries presented in Table 5, the prevalence rate is higher among women when compared to men. When compared by residence, the prevalence rate is higher among urban females than their rural counterparts. The trend is similar for urban versus rural men. This calls for gender analysis of the HIV impact so that appropriate HIV responses are designed for treatment and prevention of HIV.

## 4. Tuberculosis

The estimated incidence of tuberculosis (per 100 000 population) gives an indication of the burden of TB in a population. Consequently the task for TB control can be estimated and resources allocated accordingly. The TB incidence rate is defined by the WHO as the estimated number of new and relapse tuberculosis (TB) cases arising in a given year, expressed as the rate per 100 000 population. All forms of TB are included, including cases in people living with HIV. Incidence can change as the result of changes in transmission (the rate at which people become infected with *Mycobacterium tuberculosis*), or changes in the rate at which people infected with *Mycobacterium tuberculosis* develop TB disease (e.g. as a result of changes in nutritional status or of HIV infection). Because TB can develop in people who became infected many years previously, the effect of TB control on incidence is less rapid than the effect on prevalence or mortality. Figure 6 is a snapshot of the trend in TB incidence over the last decade.

Figure C6 Trend in TB incidence 1990 – 2013



Low-income countries experienced a surge in TB incidence during the mid-1990s to around 2002. This was partly attributed to the increasing incidence among HIV positive cases, which continuously rose from 51 in 1994 to 73 in 2003, per 100,000 population of HIV positive case, before beginning to decline in 2003. It is

notable that TB incidence rate in low-income and lower-middle-income countries is higher than the global average.

## 5. Malaria

The low-income countries bear the biggest burden of malaria mortality. Table 6 shows the trend in malaria mortality for selected countries. The number of reported malaria deaths per year is defined as the sum deaths from malaria from confirmed and probable cases.

Table C7: Number of reported deaths in selected countries

	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
Angola	7300	5736	6909	8114	10530	9465	9812	10220	13768	12459	38598	14434	9473	9510
Benin	2288	2261	1753	964	1375	918	1290	1226	322	944	560	707	468	
Burkina Faso	6294	7963	7001	9024	7982	7834	6472	8083	5224	4205	4860	4032	4233	
Burundi	3411	2263	2233	2677	1183	595	167	434	776	689	425	483	417	691
Côte d'Ivoire	3261	1534	1389	1023	18156	1249	797							
Cameroon	4349	3209	3808	4536	4943	7673	1811	930	836					
Central African Republic	1026	1442	858	526	667	456	578	865	668	859	417		535	439
Chad	1881	1359	1220	886	221	1018	617	837	558	13	1021	98	957	712
Congo	2870	623	892		116	143	113							
Democratic Republic of the Congo	30918	21601	23748	23476	21168	17940	14372	12970	15322	13613	989	2152	416	3856
Ethiopia	358	1621	936	1581	1121	1169	991	1357	1086	3327	2138	1607	1681	
Gabon	273	134	74	182	197	156	216	238	353	466	692	1141	1693	2016
Gambia	262	289	440	151	240	403	424	150	426	153	192	259	275	
Ghana	2506	2855	3259	3859	3378	3889	4622	3125	2037	1575	2103	2376	1717	6108
Guinea	108	979	743	735	586	441	472		490	528	586	440	517	626
Guinea-Bissau	418	370	472	296	369	487	370	507	565	565	1137	780	635	
India	440	519	754	1018	1144	1055	1311	1708	963	949	1006	973	1015	892
Indonesia	45	252	388	432	900	669		494	88	508				833
Kenya	360	785	713	26017				40079	44328	25403	51842	47697	48286	48767
Liberia	1191	1725		1422	1706	345	310	877	41					
Madagascar	641	552	398	427	348	355	428	441	699	715	817	575	742	591
Malawi	3723	5516	6674	8206	8915	8048	7486	6464	5070	3457	4767	5775	3355	
Mali	1680	1894	2128	3006	2331	1227	1782	1914	1285	1012	1309	826	562	748
Mozambique	2941	2818	3086	3354	3747	4424	5816							
Myanmar	236	403	581	788	972	1087	1261	1647	1707	1982	2476	2634	2814	2556
Niger	2209	2825	2802	3929	2159	2461	1358	1150	2060	1333	2248	2769	2366	1244
Nigeria	7878	7734	3353	4238	7522	8677	10289	6586	6494	6032	5343	4092	4317	
Papua New Guinea	307	381	523	616	604	628	559	668	725	619	537	647	562	617
Rwanda	409	459	380	670	809	566	1772	2486	2581	2362	2679	3167	4275	
Senegal	815	649	472	553	574	741	1935	1678	1587	1524	1602	1226	1515	1275
Sierra Leone	4326	3611	3573	8188	1734	871	324	90	50	126	157	461	328	
Sudan	685	618	612	1023	1142	1125	1254	1193	1789	1814	2479	2125	2252	2162

Togo	1361	1197	1314	1507	1556	2663	1236	819	1024	1183	1130	1661	1394	
Uganda	7277	6585	5958	8431	6296	2372	7003	4252						
Tanzania	84009	7820	11806	15867	16776	12434	12593	20962	18322	19859	15251	815	1228	379
Zambia	3548	3705	4540	4834	3862	3781	6183	6484	7737	8289	9178	9021	9369	
Zimbabwe	352	351	451	255	108	232	401	802	1916	1809	1044	1844		

Source: WHO data observatory

Some countries reported malaria deaths have consistently declined over the years 2003 to 2015. Such countries include Zimbabwe, Guinea Bissau, Kenya and Myanmar, among others. However, some countries such as Sierra Leone have had malaria deaths reported increasing over the same period. One of the reasons for such dismal performance in combating malaria could be the increasingly insufficient capacity of country level health systems to combat communicable diseases.

## Annex D

### World Health Index

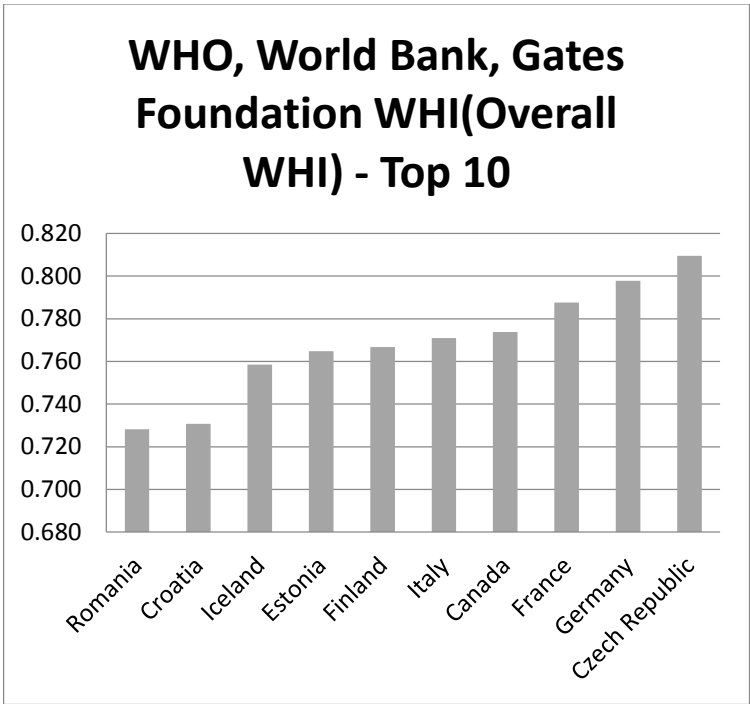
**Table D1: Dashboard of Health Indicators**

Country	GNI per capita	Poverty Head	Bottom 10% Share	Child Mortality	HIV Prevalence %	Probability of Malaria	Maternal deaths	Years of Female	World Governance voice	World Health Index
	Count < \$2	of income				Deaths per 1000	per 1000	Secondary Education	Accountability Index	
	Actual	Actual	Actual	Actual	Actual	Actual	actual	actual	actual	
Afghanistan	1960.00	0	0.310131149	97	0.1	5.1	36.1	1.96975005	15.76354694	0.467
Albania	10400.00	5	0.470180056	15	0.1		6.5		54.67980194	0.655
Algeria	13070.00				0.1		15.6	6.68758011	22.66009903	0.641
Andorra							1.5		86.69950867	0.651
Angola	7000.00	67.42	0.298947996	167	2.3	79.8	49.6	1.70456004	16.74876785	0.256
Argentina		5.74	0.50177746			0	6.5	5.7144599	58.62068939	0.734
Armenia	8180.00	11.24	0.550299965	16	0.2		7.7		30.54187202	0.632
Australia	42450.00			4	0.2	0	2.3	7.35580015	93.59606171	0.783
Austria	45450.00			4			2.2	7.64548016	95.07389069	0.792
Azerbaijan	16180.00	0.11	0.60839409	34	0.2	0	18.9	6.65693998	7.881773472	0.683
Bahamas	22700.00				3.2		7.1	5.67444992	80.78817749	0.706
Bahrain	35760.00						1.1	5.69695997	11.33004951	0.667
Bangladesh	3190.00	80.32	0.449719654	41	0.1	20.1	24.2	3.68605995	32.51231384	0.502
Barbados	15090.00				0.9		8.2	5.23577976	91.62561798	0.712
Belarus	16950.00	0.13	0.727803389	4	0.5		1.9	7.19996977	6.896551609	0.772
Belgium	41240.00			4			2.2	6.19195986	94.58128357	0.767
Belize	7870.00			17	1.5		8.6	5.07625008	66.00984955	0.662
Benin	1780.00	74.27	0.32215038	85	1.1	138.3	32.2		57.1428566	0.344
Bhutan	6920.00	29.76	0.417816242	36	0.1	2	19.1	3.98186994	43.84236526	0.600
Bolivia	5750.00	24.47	0.435569895	39	0.2	0.3	20.1	4.65059996	48.27586365	0.620
Bosnia and Herz	9660.00						4.2		46.30541992	0.607
Botswana	15640.00	27.83	0.319356476	47	23.0	18.5	22.4		61.57635498	0.443
Brazil	14750.00	12.9	0.507348358	14	0.5	0.7	9.6		60.59113312	0.655
Brunei							4.3	7.11167002	28.5714283	0.668
Bulgaria	15210.00	2.16	0.577907266	12			5.9	7.02249002	59.60591125	0.781
Burkina Faso	1440.00	72.44		98	1.0	184.1	27.2	1.38742006	34.48275757	0.279
Burundi	770.00	93.45	0.342326649	83	1.3	141.6	29.3	1.37213004	21.18226624	0.299
Cambodia	2980.00	59.39	0.42588365	38	0.7	13.4	15.7		17.73398972	0.487
Cameroon	2770.00	53.15	0.363233473	38	4.5	99.6	26.1		21.67487717	0.394
Canada	43610.00		0.571812348	5			3.3	6.06543016	95.56650543	0.844
Cape Verde	6210.00	34.7	0.451618808	26	0.5		12.6	5.75207996	76.35468292	0.683
Chad	2000.00	60.54	0.27784125	148	2.7	87.7	39.9	0.95139998	10.83743858	0.267
Chile	21030.00	3.12	0.44539703	8			5.1	5.40828991	5.418719292	0.679
China	11850.00	36.03	0.513131388	13	0.5	0.1	5.9	4.90581989	45.81280899	0.678
Colombia	11960.00	17.72	0.439473005	17		0.1	8.8	6.0831399	36.45320129	0.682
Comoros	1490.00		0.313318708	78		57.1	34.7		11.82266045	0.431
Congo, Dem Rep	740.00	95.15	0.3209367	119	1.1	145.8	30.6	1.79084003	18.22660065	0.266
Cook Islands			0.51447711							
Costa Rica	13570.00	7.32	0.43731802	10	0.2	0	6.3	5.03077984	83.74384308	0.743
Cote d'Ivoire	3090.00	59.07		100	3.2	141.7	38.6		32.01970291	0.273
Croatia	20830.00		0.557592538	5			2.7	8.16421986	63.54679871	0.817
Cuba	18520.00		0.665918847		0.2		2.4	5.31882	6.403940678	0.736
Cyprus	27630.00		0.525717445		0.1		1.5	5.54129982	77.8325119	0.800
Czech Republic	26740.00	0.03	0.63074246	4	0.1		1.9	7.75895023	97.04433441	0.871
Denmark	44950.00		0.642217314	4	0.2		2.6	7.34877014	8.866994858	0.784
Dominican Repu	11630.00	14.59	0.444545175	28	0.7		22.1	4.84424999	39.40886688	0.632
Ecuador	10720.00	18.7	0.451648141	23	0.4	0.1	11.1	5.1792798	1.970443368	0.621
Egypt	10790.00			22		0.1	13.3	4.46064997	1.477832556	0.576
El Salvador	7490.00	15.76		16	0.5	0.1	8.6	3.93410993	85.22167206	0.654
Equatorial Guinea							33.7	..	12.80788136	
Eritrea							18.8	..	46.79803085	
Estonia	24570.00	1.23	0.587117108	3	1.3		1.7	6.4168601	98.02955627	0.837
Ethiopia	1380.00		0.286425199	64	1.3	55.3	28.5	..	89.16255951	
Fiji	7590.00	22.9	0.443703446	24	0.1		9.8	..	64.53202057	
Finland	39930.00		0.670022667	3			1.3	6.60011005	67.48768616	0.844
France	38530.00		0.640753811	4			2.3	7.69334984	73.89162445	0.855
Gabon	17230.00	20.88	0.340851808	56	4.0	111.9	23.8	..	34.9753685	
Gambia	1610.00		0.268040381	74	1.3	93.3	30.7	3.33983994	24.13793182	0.456
Georgia	7040.00	32.88	0.578502885	13	0.3	0.1	7.6	..	20.6896553	
Germany	45620.00		0.67739375	4	0.1		2.2	8.75261974	54.18719101	0.862
Ghana	3900.00	51.84	0.334838685	78	1.4	96.7	29	..	25.12315178	
Greece	25700.00	..	0.610050975	4			3	6.44224977	33.49753571	0.774
Grenada	11230.00		0.385260975				6.2	5.53070021	66.99507141	0.733
Guatemala	7130.00	29.79	0.39615131	31	0.6		13.8	3.20903993	61.08374405	0.619
Guinea	1160.00	65.92		101	1.7	121.7	31.8	..	53.20196915	
Guinea-Bissau	1410.00			124	3.9	142.7	40.6	..	4.92610836	
Honduras	4270.00	39.48	0.441724182	22	0.5	0.2	11.4	4.04476023	91.13300323	0.672
Hungary	22800.00	0	0.594353842	6			3.6	7.95073986	15.27093601	0.766
Iceland	41160.00	..	0.694482098				1	7.73631001	42.36453247	0.839
India	5350.00	59.2391536	0.445021355	53	0.3	4.9	28.6	4.34960985	76.84729004	0.576
Indonesia	9270.00	54.13	0.455118873	29	0.5	4.2	14	4.72543001	0.985221684	0.558
Iran	15610.00	8.03	0.434112886	17	0.1	0.1	9.8	5.53052998	68.96551514	0.722
Iraq	14930.00	21.17	0.430584057	34		0.1	19	..	40.39408875	
Ireland	39250.00		0.669713745	4			2.3	6.10595989	29.06403923	0.791
Israel	32140.00		0.598901104	4			2.2	6.20511007	4.433497429	0.744
Italy	35540.00		0.589423339	4	0.3		2.1	7.98305988	71.92118073	0.844
Jamaica	8490.00			17	1.8		12	4.63704014	33.99014664	0.612
Japan	37790.00		0.662602258	3			1	6.09621	51.72413635	0.816
Jordan	11670.00	2.88	0.478225445	19		0.1	11	5.49010992	38.91625595	0.696
Kazakhstan	20680.00	0.65	0.622263788	16		7.5	..		16.25615692	
Kenya	2780.00	67.21	0.368189234	71	6.1	63.4	22.9	..	93.10344696	
Korea	33440.00			4		0.1	1.7	5.79596996	35.96059036	0.691
Kuwait	88170.00						3.4	..	31.52709389	
Kyrgyzstan	3080.00	45.31	0.573861593	24	0.2	0.1	12.1	5.92892981	44.82758713	0.664
Lao	4550.00	68.25	0.433151832	71	0.1	11.6	30.7	2.4456799	36.94581223	0.471
Latvia	22510.00	1.86	0.573204802	8			5.4	5.73676014	85.7142868	0.801
Lebanon	17400.00						5	4.49915981	..	
Lesotho	3160.00	73.39	0.311055001	98	23.1	33.4	33.4	3.03116012	23.15270996	0.317

## Tailored WHI Indices

UNICEF focuses more on child mortality, the bottom ranked countries in the UNICEF WHI are Chad, Angola, DRC, Niger, Zambia, Uganda, Burkina Faso, Burundi Sierra Lone, Cote d’Ivoire. These countries would need more focus.

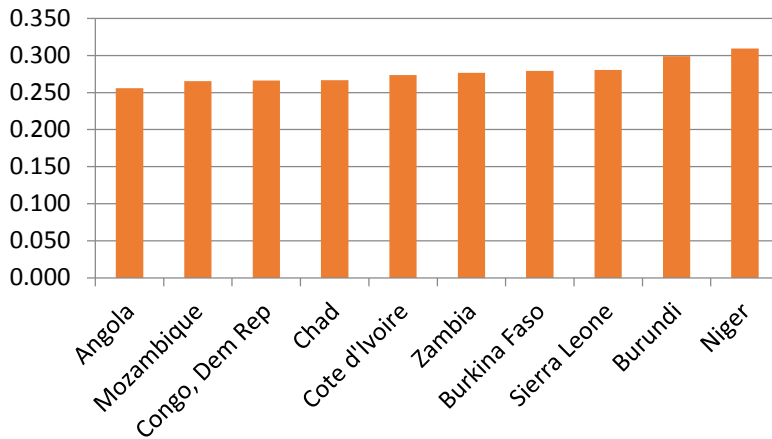
Regarding the Global Fund and UNAIDS, where the focus is on HIV/AIDS, TB, and Malaria, the bottom countries in the tailored WHI, the bottom 10 countries are Zambia, Mozambique, Uganda, Burkina Faso, DRC, Burundi, Cote d’Ivoire, Niger, Chad, and Lesotho.



**Figure D1a: Overall WHI for WHO, World Bank, gate Foundation (top 10 countries)**

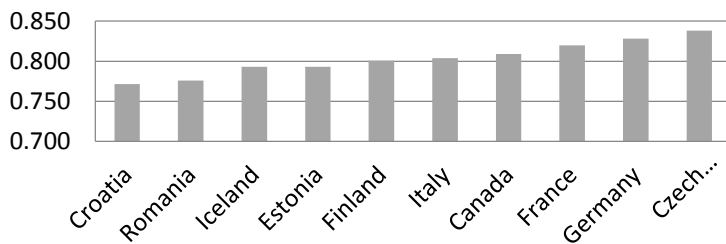


### WHO, World Bank, Gates Foundation WHI(Overall WHI) - Bottom 10



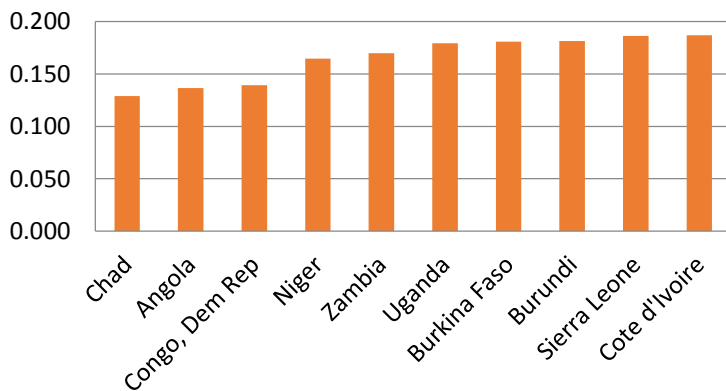
**Figure D1b: Overall WHI for WHO, World Bank, gate Foundation (bottom 10 countries)**

### UNICEF WHI - Top 10

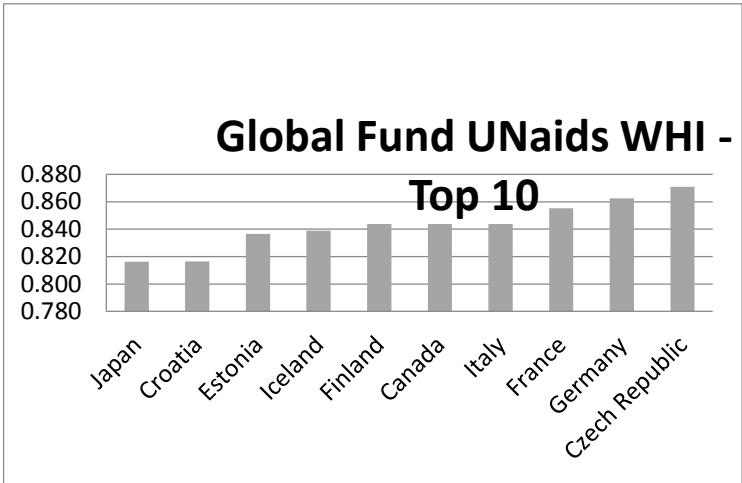


**Figure D2a: WHI for UNICEF (top 10 countries)**

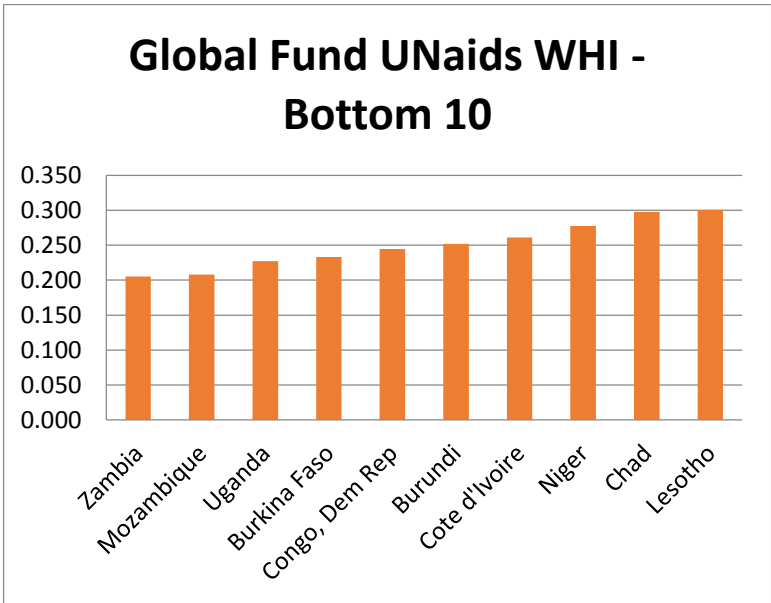
### UNICEF WHI - Bottom 10



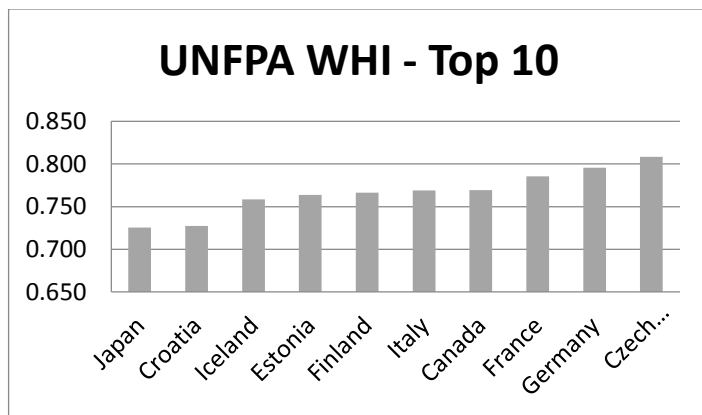
**Figure D2b: WHI for UNICF(bottom 10 countries)**



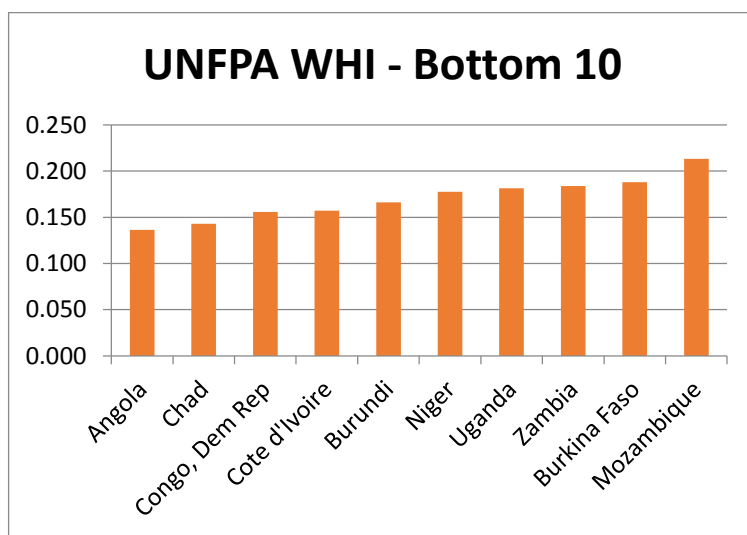
**Figure D3a: WHI for Global Fund and UNAIDS(top 10 countries)**



**Figure D3b: WHI for Global Fund and UNAIDS(bottom 10 countries)**



**Figure D4a: WHI for UNFPA (top 10 countries)**



**Figure D4b: WHI for UNFPA(bottom 10 countries)**

For the WHI for UNFPA, the bottom countries need the most focus are Angola, Chad, DRC, Cote d'Ivoire, Burundi, Niger, Uganda, Zambia, Burkina Faso, and Mozambique.

In all the tailored indices we included the indicator on Voice and accountability and female education. Notice that the countries needing most support, as they are in the bottom 10, are the same group of countries with minimal variation and some change in the ranking.

Country	GNI per capita (Atlas)	DALYs lost Category			OOP in %	Mean income in PPP per day	Poverty gap (% of pov. line)	Ratio (A/B)	Inefficiency	Position on the health development path	GNI per capita	Ranking	
		All	I	II and III								Projection	GNI per capita adjusted for DALYs
Slovenia	28,780	0.31	0.01	0.30	12.1	30.2	0.00	27026.0	1.39	0%	1	1	1
Czech Republic	26,740	0.32	0.02	0.30	15.7	22.4	0.00	2206.0	0.92	15%	2	3	2
Trinidad and Tobago	26,220	0.41	0.05	0.36	42.5	9.2	0.10	10.3	0.33	48%	3	28	4
Slovakia	26,110	0.33	0.02	0.31	22.1	23.1	0.01	592.4	0.64	23%	4	5	3
Estonia	24,570	0.37	0.02	0.35	18.9	17.7	0.02	136.4	0.19	31%	5	10	5
Lithuania	24,550	0.40	0.02	0.38	32.6	14.7	0.02	94.6	0.19	34%	6	12	6
Russia	23,190	0.51	0.05	0.46	48	16.3	0.01	186.9	1.22	31%	7	9	9
Hungary	22,800	0.41	0.01	0.40	27.5	14.6	0.01	214.6	0.00	28%	8	8	7
Poland	22,790	0.34	0.02	0.32	22.8	12.3	0.02	102.9	-0.04	33%	9	11	8
Malaysia	22,530	0.25	0.05	0.20	36.1	14.5	0.06	35.4	0.69	41%	10	19	11
Latvia	22,510	0.43	0.02	0.41	36.5	14.0	0.04	54.7	0.10	37%	11	15	10
Chile	21,030	0.23	0.02	0.21	31.7	16.9	0.04	61.2	-0.08	36%	12	13	12
Croatia	20,830	0.36	0.01	0.35	12.5	21.0	0.00	2156.3	0.60	15%	13	2	13
Kazakhstan	20,680	0.41	0.05	0.36	46.3	7.7	0.05	15.3	0.44	45%	14	25	14
Panama	19,300	0.27	0.06	0.21	24.9	13.6	0.11	17.9	0.60	45%	15	23	16
Uruguay	18,940	0.31	0.03	0.28	17	16.1	0.04	67.2	0.33	36%	16	14	15
Turkey	18,800	0.28	0.04	0.24	15	11.3	0.06	24.1	0.28	42%	17	21	17
Romania	18,410	0.38	0.03	0.35	19.7	7.0	0.07	7.5	-0.42	48%	18	31	18
Venezuela	17,900	0.28	0.04	0.23	65.8	8.2	0.16	5.6	-0.03	51%	19	38	19
Gabon	17,230	0.56	0.33	0.23	38.9	5.1	0.27	1.3	1.57	63%	20	57	33
Belarus	16,950	0.45	0.03	0.42	31.9	16.7	0.00	2125.4	1.29	16%	21	4	20
Azerbaijan	16,180	0.31	0.06	0.25	71.1	7.5	0.08	8.6	0.49	49%	22	33	22
Mexico	16,110	0.25	0.04	0.21	44.1	10.7	0.10	13.8	0.07	45%	23	24	21

Botswana	15,640	0.52	0.30	0.22	5.4	8.4	0.28	3.8	1.79	57%	24	48	36
Iran	15,610	0.28	0.04	0.23	52.1	7.7	0.12	6.3	0.04	50%	25	37	23
Bulgaria	15,210	0.43	0.02	0.41	39.6	10.8	0.06	23.7	-0.23	42%	26	20	24
Iraq	14,930	0.32	0.10	0.22	36.5	3.5	0.35	0.2	-0.20	70%	27	69	27
Brazil	14,750	0.31	0.05	0.26	29.9	12.7	0.12	14.8	0.33	45%	28	26	26
Montenegro	14,410	0.34	0.02	0.32	42.7	9.6	0.04	30.1	-0.47	40%	29	18	25
Costa Rica	13,570	0.22	0.02	0.20	23.3	15.6	0.06	39.3	0.00	39%	30	17	28
Thailand	13,430	0.32	0.06	0.26	11.3	7.6	0.12	6.0	0.30	51%	31	39	29
Algeria	13,070	0.30	0.06	0.24	25.1	6.0	0.17	2.6	0.13	56%	32	46	31
Serbia	12,480	0.38	0.02	0.37	37.9	10.2	0.03	43.3	-0.44	37%	33	16	30
South Africa	12,240	0.62	0.35	0.28	7.1	10.5	0.28	5.4	2.05	55%	34	44	48
Colombia	11,960	0.26	0.05	0.21	13.9	10.4	0.17	8.2	0.18	49%	35	32	34
China	11,850	0.26	0.03	0.24	33.9	5.6	0.25	1.8	-0.80	57%	36	49	32
Jordan	11,670	0.24	0.05	0.19	23.5	7.2	0.09	6.8	0.21	50%	37	35	35
Dominican Rep.	11,630	0.28	0.07	0.21	39	8.6	0.16	6.3	0.46	51%	38	40	37
Peru	11,160	0.25	0.06	0.19	34.9	10.0	0.13	9.8	0.46	48%	39	30	38
Egypt	10,790	0.31	0.06	0.25	58	3.8	0.32	0.4	-0.53	67%	40	64	40
Ecuador	10,720	0.28	0.06	0.21	45	9.0	0.14	7.3	0.46	50%	41	36	42
Tunisia	10,610	0.26	0.04	0.22	35.5	7.6	0.11	6.6	-0.07	50%	42	34	39
Albania	10,400	0.33	0.03	0.30	51.5	6.4	0.10	4.6	-0.48	51%	43	41	41
Maldives	9,900	0.20	0.04	0.17	37.5	8.8	0.09	10.8	0.06	47%	44	27	43
Bosnia	9,660	0.32	0.02	0.31	29	18.4	0.01	538.9	0.36	23%	45	6	44
Namibia	9,490	0.41	0.21	0.19	7.1	5.5	0.41	1.4	1.16	62%	46	55	51
Sri Lanka	9,470	0.29	0.04	0.25	46.5	4.1	0.31	0.6	-0.75	64%	47	58	45
Indonesia	9,270	0.32	0.10	0.22	45.8	3.0	0.46	0.2	-0.20	71%	48	70	47
Ukraine	8,970	0.48	0.05	0.43	42.8	12.2	0.00	591.0	1.55	24%	49	7	46
Jamaica	8,490	0.32	0.07	0.25	25	11.3	0.08	19.4	0.86	45%	50	22	50
Armenia	8,180	0.40	0.03	0.37	54.7	3.8	0.32	0.4	-1.08	66%	51	62	49
Belize	7,870	0.26	0.06	0.20	26.2	6.7	0.27	2.6	0.09	56%	52	45	52
Philippines	7,840	0.34	0.10	0.24	56.7	3.4	0.44	0.4	0.00	68%	53	65	56

Paraguay	7,670	0.27	0.06	0.21	56.6	11.1	0.15	10.3	0.50	48%	54	29	53
Fiji	7,590	0.35	0.06	0.29	20.9	5.4	0.26	1.5	-0.02	59%	55	52	54
El Salvador	7,490	0.33	0.06	0.28	28.4	6.9	0.18	3.6	0.10	54%	56	43	55
Guatemala	7,130	0.33	0.12	0.21	51.8	5.2	0.35	1.3	0.58	61%	57	54	59
Georgia	7,040	0.38	0.04	0.34	61.9	3.6	0.39	0.4	-0.98	66%	58	61	57
Morocco	7,000	0.34	0.09	0.25	58.4	5.7	0.22	2.0	0.34	58%	59	50	58
Angola	7,000	1.13	0.79	0.34	24.4	2.0	0.62	0.1	1.48	82%	60	92	81
Bhutan	6,920	0.38	0.12	0.27	25.4	4.9	0.26	1.1	0.47	62%	61	56	60
Cape Verde	6,210	0.27	0.08	0.19	23.1	4.0	0.38	0.6	-0.08	65%	62	59	61
Swaziland	6,060	0.78	0.52	0.26	10.6	2.7	0.56	0.2	1.48	74%	63	71	69
Bolivia	5,750	0.40	0.14	0.26	19.8	8.9	0.16	6.6	1.20	52%	64	42	62
Nigeria	5,360	0.92	0.64	0.28	69.3	1.4	0.71	0.0	1.02	86%	65	97	75
India	5,350	0.44	0.16	0.27	58.2	2.2	0.57	0.1	-0.04	78%	66	80	64
Vietnam	5,070	0.28	0.06	0.22	49.4	4.0	0.32	0.5	-0.41	65%	67	60	63
Pakistan	4,840	0.48	0.23	0.25	54.9	2.4	0.52	0.1	0.27	79%	68	83	67
Lao	4,550	0.45	0.23	0.22	40	2.1	0.59	0.1	0.29	79%	69	84	68
Nicaragua	4,510	0.28	0.06	0.22	40	6.4	0.23	2.5	0.13	56%	70	47	65
Honduras	4,270	0.29	0.08	0.21	45.1	6.2	0.33	2.0	0.31	58%	71	51	66
Ghana	3,900	0.56	0.32	0.24	36.2	3.5	0.42	0.4	1.15	70%	72	68	73
Yemen	3,820	0.47	0.25	0.23	74.1	3.6	0.37	0.4	0.90	70%	73	66	70
Zambia	3,810	0.77	0.54	0.23	27.8	1.3	0.77	0.1	1.13	81%	74	88	78
Bangladesh	3,190	0.33	0.12	0.21	60.2	1.8	0.64	0.0	-0.62	84%	75	94	72
Lesotho	3,160	0.89	0.61	0.27	14.4	2.4	0.60	0.2	1.56	76%	76	77	84
Cote d'Ivoire	3,090	0.90	0.58	0.32	51.2	2.2	0.58	0.1	1.30	79%	77	82	83
Kyrgyzstan	3,080	0.34	0.07	0.27	36.4	3.8	0.33	0.4	-0.30	67%	78	63	71
Cambodia	2,980	0.38	0.16	0.22	59.7	2.8	0.47	0.1	0.08	75%	79	74	74
Mauritania	2,850	0.57	0.36	0.21	46.3	2.8	0.50	0.2	1.02	75%	80	73	76
Kenya	2,780	0.61	0.40	0.21	44.6	2.4	0.58	0.2	1.11	75%	81	76	79
Cameroon	2,770	0.77	0.50	0.28	61.5	2.8	0.50	0.2	1.34	75%	82	75	82
Papua New G.	2,430	0.50	0.26	0.25	11	6.3	0.27	2.2	1.48	59%	83	53	77
Senegal	2,210	0.50	0.30	0.20	36.9	2.2	0.57	0.1	0.62	79%	84	81	80

Chad	2,000	1.06	0.80	0.26	61	2.2	0.58	0.1	1.62	80%	85	85	102
Benin	1,780	0.64	0.40	0.25	40.9	1.8	0.66	0.1	0.79	81%	86	89	86
Tanzania	1,760	0.59	0.37	0.23		1.8	0.64	0.1	0.65	82%	87	91	85
Sierra Leone	1,690	1.25	0.87	0.38	61.3	1.5	0.70	0.0	1.18	90%	88	101	105
Gambia	1,610	0.63	0.40	0.23	21	2.7	0.54	0.2	1.16	74%	89	72	91
Mali	1,540	0.87	0.60	0.28	60.1	1.5	0.68	0.0	0.48	95%	90	104	95
Comoros	1,490	0.57	0.33	0.24	45.1	2.9	0.62	0.4	1.18	70%	91	67	88
Uganda	1,470	0.70	0.45	0.26	38.4	2.3	0.59	0.1	1.16	77%	92	78	93
Rwanda	1,450	0.51	0.28	0.23	18.4	1.7	0.72	0.1	0.59	78%	93	79	87
Burkina Faso	1,440	0.73	0.47	0.26	33.2	2.0	0.62	0.1	0.99	81%	94	87	94
Guinea-Bissau	1,410	0.87	0.60	0.27	43.3	1.6	0.67	0.0	0.86	88%	95	100	98
Ethiopia	1,380	0.53	0.33	0.20	35.4	1.8	0.64	0.0	0.44	84%	96	95	92
Madagascar	1,370	0.51	0.29	0.22	30.1	0.8	0.84	0.0	-0.25	93%	97	103	90
Togo	1,180	0.73	0.47	0.25	40.5	1.8	0.66	0.1	0.92	82%	98	93	96
Nepal	1,160	0.37	0.14	0.23	46.2	2.2	0.56	0.1	-0.29	80%	99	86	89
Guinea	1,160	0.76	0.50	0.26	56.4	1.8	0.64	0.0	0.74	87%	100	98	97
Mozambique	1,100	0.85	0.59	0.26	6.4	1.6	0.70	0.1	1.19	81%	101	90	100
Niger	890	0.81	0.58	0.23	53.1	1.7	0.65	0.0	0.86	88%	102	99	103
Liberia	790	0.59	0.37	0.22	26	1.2	0.76	0.0	0.16	91%	103	102	99
Burundi	770	0.86	0.56	0.30	20.2	1.0	0.79	0.0	0.13	100%	104	106	104
Malawi	750	0.66	0.46	0.20	11.7	1.2	0.77	0.0	0.76	84%	105	96	101
Congo, Dem Rep	740	1.06	0.75	0.31	21.7	0.8	0.83	0.0	0.68	96%	106	105	106

**Table B4a: re-ranking of countries according to the different methods.**

**Table B4b: re-ranking of countries using the \$1.25 vs \$4.71 health poverty lines**

Country	GNI per capita (Atlas)	DALYs lost			OOP in %	Mean income in PPP per day	Ranking					
		All	Category I	II and III			GNI per capita	Projection 1.25	Projection 4.71	GNI per capita adjusted for DALYs	Projection 1.25 with OOP	Projection 4.71 with OOP
Czech Republic	26,740	0.32	0.02	0.30	15.7	26.3	1	5	1	1	4	1
Trinidad and Tobago	26,220	0.41	0.05	0.36	42.5	21.5	2	8	7	3	9	8
Slovakia	26,110	0.33	0.02	0.31	22.1	28.0	3	4	2	2	5	2
Estonia	24,570	0.37	0.02	0.35	18.9	23.1	4	31	4	4	23	5
Lithuania	24,550	0.40	0.02	0.38	32.6	19.8	5	23	8	5	24	6
Hungary	22,800	0.41	0.01	0.40	27.5	18.7	6	11	3	6	7	3
Latvia	22,510	0.43	0.02	0.41	36.5	17.9	7	29	10	7	28	11
Chile	21,030	0.23	0.02	0.21	31.7	21.9	8	14	9	8	14	7
Panama	19,300	0.27	0.06	0.21	24.9	19.9	9	24	15	10	21	15
Uruguay	18,940	0.31	0.03	0.28	17	23.0	10	3	5	9	3	4
Venezuela	17,900	0.28	0.04	0.23	65.8	13.9	11	47	20	11	51	28
Gabon	17,230	0.56	0.33	0.23	38.9	7.4	12	35	41	19	38	41
Mexico	16,110	0.25	0.04	0.21	44.1	12.2	13	18	18	12	18	20
Botswana	15,640	0.52	0.30	0.22	5.4	11.2	14	41	36	21	29	18
Iran	15,610	0.28	0.04	0.23	52.1	18.1	15	1	6	13	2	10
Bulgaria	15,210	0.43	0.02	0.41	39.6	15.7	16	20	13	14	20	13
Brazil	14,750	0.31	0.05	0.26	29.9	17.5	17	33	16	16	37	16
Montenegro	14,410	0.34	0.02	0.32	42.7	13.6	18	15	11	15	16	12
Costa Rica	13,570	0.22	0.02	0.20	23.3	21.7	19	19	12	17	15	9
South Africa	12,240	0.62	0.35	0.28	7.1	11.9	20	42	38	29	34	23
Colombia	11,960	0.26	0.05	0.21	13.9	13.3	21	36	23	20	31	17



China	11,850	0.26	0.03	0.24	33.9	8.4	22	22	29	18	22	31
Dominican Republic	11,630	0.28	0.07	0.21	39	11.8	23	21	22	22	25	25
Peru	11,160	0.25	0.06	0.19	34.9	13.6	24	25	19	23	27	19
Ecuador	10,720	0.28	0.06	0.21	45	11.3	25	38	24	26	41	30
Tunisia	10,610	0.26	0.04	0.22	35.5	9.7	26	10	21	24	8	21
Albania	10,400	0.33	0.03	0.30	51.5	7.4	27	9	25	25	12	32
Namibia	9,490	0.41	0.21	0.19	7.1	8.3	28	48	42	32	36	29
Sri Lanka	9,470	0.29	0.04	0.25	46.5	7.0	29	7	35	27	11	38
Indonesia	9,270	0.32	0.10	0.22	45.8	5.0	30	30	49	28	33	50
Jamaica	8,490	0.32	0.07	0.25	25	14.8	31	2	14	31	1	14
Armenia	8,180	0.40	0.03	0.37	54.7	5.9	32	16	39	30	19	42
Belize	7,870	0.26	0.06	0.20	26.2	9.3	33	50	32	33	44	34
Philippines	7,840	0.34	0.10	0.24	56.7	5.7	34	34	45	37	40	47
Paraguay	7,670	0.27	0.06	0.21	56.6	15.1	35	28	17	34	32	22
Fiji	7,590	0.35	0.06	0.29	20.9	8.5	36	12	30	35	6	26
El Salvador	7,490	0.33	0.06	0.28	28.4	9.2	37	26	27	36	26	27
Guatemala	7,130	0.33	0.12	0.21	51.8	8.6	38	43	37	40	47	39
Georgia	7,040	0.38	0.04	0.34	61.9	5.5	39	45	44	38	50	46
Morocco	7,000	0.34	0.09	0.25	58.4	9.3	40	6	26	39	13	35
Angola	7,000	1.13	0.79	0.34	24.4	4.1	41	58	58	58	57	54
Bhutan	6,920	0.38	0.12	0.27	25.4	8.0	42	13	33	41	10	33
Swaziland	6,060	0.78	0.52	0.26	10.6	3.8	43	64	57	49	55	49
Bolivia	5,750	0.40	0.14	0.26	19.8	12.1	44	49	28	42	43	24
Nigeria	5,360	0.92	0.64	0.28	69.3	2.6	45	74	72	52	79	76
India	5,350	0.44	0.16	0.27	58.2	3.8	46	40	54	45	45	60
Uzbekistan	5,290	0.34	0.08	0.26	46.1	3.3	47	54	59	43	54	64
Vietnam	5,070	0.28	0.06	0.22	49.4	8.1	48	17	31	44	17	36
Pakistan	4,840	0.48	0.23	0.25	54.9	4.1	49	27	52	48	30	59
Nicaragua	4,510	0.28	0.06	0.22	40	8.3	50	39	34	46	42	37
Honduras	4,270	0.29	0.08	0.21	45.1	7.8	51	52	40	47	52	40

Ghana	3,900	0.56	0.32	0.24	36.2	6.1	52	51	47	51	49	45
Zambia	3,810	0.77	0.54	0.23	27.8	2.8	53	75	65	55	75	65
Lesotho	3,160	0.89	0.61	0.27	14.4	2.7	54	78	67	61	71	58
Cote d'Ivoire	3,090	0.90	0.58	0.32	51.2	4.0	55	59	56	60	65	63
Kyrgyzstan	3,080	0.34	0.07	0.27	36.4	5.1	56	32	46	50	35	44
Mauritania	2,850	0.57	0.36	0.21	46.3	5.7	57	46	48	53	48	51
Kenya	2,780	0.61	0.40	0.21	44.6	4.8	58	55	51	56	59	53
Cameroon	2,770	0.77	0.50	0.28	61.5	4.2	59	53	53	59	56	61
Papua New Guinea	2,430	0.50	0.26	0.25	11	3.7	60	60	55	54	53	48
Senegal	2,210	0.50	0.30	0.20	36.9	3.2	61	62	63	57	62	66
Chad	2,000	1.06	0.80	0.26	61	3.4	62	67	64	78	72	71
Benin	1,780	0.64	0.40	0.25	40.9	2.8	63	68	66	62	70	69
Sierra Leone	1,690	1.25	0.87	0.38	61.3	2.4	64	71	78	81	76	80
Gambia	1,610	0.63	0.40	0.23	21	3.2	65	66	62	67	61	57
Mali	1,540	0.87	0.60	0.28	60.1	2.3	66	72	79	71	77	82
Comoros	1,490	0.57	0.33	0.24	45.1	7.8	67	44	43	64	46	43
Uganda	1,470	0.70	0.45	0.26	38.4	3.6	68	57	60	69	60	62
Rwanda	1,450	0.51	0.28	0.23	18.4	2.9	69	69	61	63	63	55
Burkina Faso	1,440	0.73	0.47	0.26	33.2	2.8	70	65	71	70	66	70
Guinea-Bissau	1,410	0.87	0.60	0.27	43.3	2.5	71	76	70	74	78	74
Ethiopia	1,380	0.53	0.33	0.20	35.4	3.0	72	56	68	68	58	68
Madagascar	1,370	0.51	0.29	0.22	30.1	1.4	73	81	80	66	82	78
Togo	1,180	0.73	0.47	0.25	40.5	2.7	74	73	69	72	74	72
Nepal	1,160	0.37	0.14	0.23	46.2	4.5	75	37	50	65	39	52
Guinea	1,160	0.76	0.50	0.26	56.4	2.9	76	61	73	73	67	75
Mozambique	1,100	0.85	0.59	0.26	6.4	2.2	77	77	74	76	64	56
Niger	890	0.81	0.58	0.23	53.1	2.5	78	63	77	79	68	77
Liberia	790	0.59	0.37	0.22	26	2.5	79	70	75	75	69	73
Burundi	770	0.86	0.56	0.30	20.2	1.6	80	80	82	80	80	81
Malawi	750	0.66	0.46	0.20	11.7	1.9	81	79	76	77	73	67

Congo, Dem Rep	740	1.06	0.75	0.31	21.7	1.5	82	82	81	82	81	79
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