

Spending targets for health: no magic number

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SUMMARY

Key observations and policy messages:

- This paper provides evidence which supports the message that all countries can make progress towards UHC, including those with very low levels of public spending on health (<40 \$ per capita).
- Levels of public spending are central to UHC progress; in terms of service coverage as levels of public spending increase we observe both systematic improvements in UHC performance within countries, as well as convergence across countries.
- Whilst financial protection also improves with public spending (especially >\$200 per capita), progress remains highly variable across countries even at >\$520 per capita (one of our spending quintile thresholds). Improving financial protection can be complex, requiring both the systematic development of policy, and the institutions that govern and manage health systems.

Motivation and objectives:

- A number of health expenditure targets exist and are widely referred to. These include targets based on absolute spending amounts, and those based on spending relative to a denominator such as GDP or total government spending; those based on detailed bottom-up costing and those without a clear evidence base; and some which clearly refer to public health spending, and others which imply total health spending.
- Targets send the message to countries that at lower spending levels little or no progress can be made in terms of service coverage and financial protection, which is clearly not the case given the considerable variability across countries with similar levels of public expenditure on health.

Methods, indicators and data:

- We use data envelopment analysis (DEA) to assess and compare performance on agreed indicators for **both service coverage and financial protection**, relative to a country's level of public spending on health in per capita terms.
- We measure performance using five service coverage indicators (DPT3, ART, TB, family planning, skilled attendance at birth), and one measure of financial protection using public expenditure on health as % total health expenditure as a proxy measure, given the lack of widespread data on our preferred indicators.
- The latest validated and published data (2012 or most recent) are analysed for 83 low and middle-income countries.

Key results:

- We observe high levels of variation across countries in terms of UHC performance at very low levels of public spending i.e. <PPP\$ 40 per capita; some countries achieve a performance less than half of others with a similar levels of spending.
- UHC performance improves as countries increase public spending on health; convergence in performance between countries is also observed as spending increases. This convergence is driven primarily by improvements in service coverage, and occurs rapidly, once countries spend more than PPP\$ 40 per capita.
- In terms of financial protection, significant improvement is observed across our sample of countries only once public spending is greater than PPP\$ 200 per capita; convergence across countries is not observed, however. Even at higher levels of public spending there remains significant variation in how well countries translate greater public spending on health into financial protection for their citizens.

1. More money for health, more health for the money

a) Background

The World Health Report 2010 [1] put forward two central messages; first that countries need to ensure adequate spending on health to make progress on UHC and, secondly, that improving spending efficiency is central to the UHC agenda. This perspective has been reinforced by the adoption in 2015 of both the Sustainable Development Goals (SDGs), and the Addis Ababa Action Agenda on Financing for Development, which also recognise the need to explore the nature of the resources available for health systems, and the use to which they are put, rather than focusing solely on estimates of the level of resources required to make progress toward UHC. How public resources are used has a direct impact on both levels of service and financial coverage, as well as how equitably both are distributed [2].

This paper considers these issues in the context of low and middle-income countries. A number of estimates of how much countries should spend on health exist, are widely referred to in policy discussions, and in some cases can play a useful role in advocating for greater investment in the health sector. However, there is no single or simple answer to this question [3], and many benchmarks or spending estimates offer little in terms of useful guidance to country policy makers. Worse still, these estimates may divert policy focus away from improving the way existing money is being spent. In the analysis which follows we aim to provide insights for country policy makers by systematically analysing how performance varies across countries in terms of the two main dimensions of UHC (service coverage and financial protection), relative to levels of health spending.

b) Health spending targets

Health spending targets widely used in policy discussions concerning low and middle-income countries are summarised below. A more complete list is provided in Annex 1.

Relative targets: The Abuja Declaration of 2001 recommended that governments allocate 15% of their budgets to the health sector, although the basis for this figure is not clear, with no explicit connection to achieving a certain level of health system performance. Whilst focused on the African Region, this target is widely referred to. In 2012 only 14% of governments in low and lower-middle income countries met the Abuja target; indeed, only 29% of upper-middle income and high-income countries reached this level¹; as a result the target is rarely considered useful or relevant to country policy makers.

An indicator which is increasingly used, and which builds on the Abuja Declaration target, is the amount a country spends in terms of public spending on health as a %GDP. This indicator captures both the priority given to health in budget allocations, as well as the fiscal context i.e. how large government is relative to the economy, measured in terms of “total public spending as %GDP”. The World Health Report 2010 noted that “...it is *difficult to get close to universal health coverage at less than 4–5% of GDP*²”.

¹ Author calculations based on WHO Global Health Expenditure Database (GHED).

² See Table 5.2 on p98.

Subsequent analysis [4] makes a similar assertion saying that “*Ensuring financial protection at an adequate level generally requires GHE³/GDP of at least 5 per cent. For example, such a ratio is generally required for limiting the proportion of out-of-pocket payments to 20 per cent of THE, which in turn is generally needed for achieving low rates of catastrophic and impoverishing health expenditure.*” The explicit link between this spending indicator and financial protection, a fundamental objective of UHC, is more useful, and refers to previous analysis [5] which looks at the correlation between a health systems reliance on direct out-of-pocket payments and levels of catastrophic and impoverishing spending.

Absolute targets: the World Health Report 2010 also presents estimates of required health spending prepared by the High-Level Taskforce on Innovative International Financing for Health Systems [6]. The report concluded that low-income countries would need to spend on average US\$60 per capita by 2015 in order to deliver a set of essential health interventions⁴, with the caveat that for some countries the figure would be less than US\$40 per capita, and in others more than US\$80 per capita. Subsequently, these estimates were independently updated to 2012 US dollar terms (from 2005) resulting in an average figure of \$86 per capita [4], which was clearer in explicitly referring to the required level of government or public health expenditure.

Estimates are not always explicit in referring to public rather than total spending on health, which is problematic given that public and private revenue sources impact very differently on how well countries perform in terms of UHC [7]. In 2012, whilst all governments in high and upper-middle income countries spent at least \$86 per capita on health, only 33 or 72% of lower-middle income countries, and just two low-income countries (Kyrgyzstan⁵ and Rwanda)⁶, reached this level.

c) Variation in UHC performance

One downside of these estimates of health spending requirements is that they hide wide variation in performance across countries. In some cases, policy makers may consider that unless they reach, or are close to reaching these levels of health spending, they will be seriously limited in the progress they can make towards UHC. Clearly this is not necessarily the case; for example public spending on health as %GDP in Thailand today is significantly less than 4%, and stood at around 2.2% when the Universal Coverage Scheme was introduced in 2004. Whilst variation across countries spending at similar levels will be due to a wide range of factors, including many beyond the health system, the way in which health systems are organised is likely to at least partially explain performance variation [8].

³ In the report the authors use GHE to refer to government health expenditure, equivalent to public spending on health, and referred elsewhere in this paper as GGHE (general government health expenditure) in line with NHA terminology. THE refers to total health expenditure.

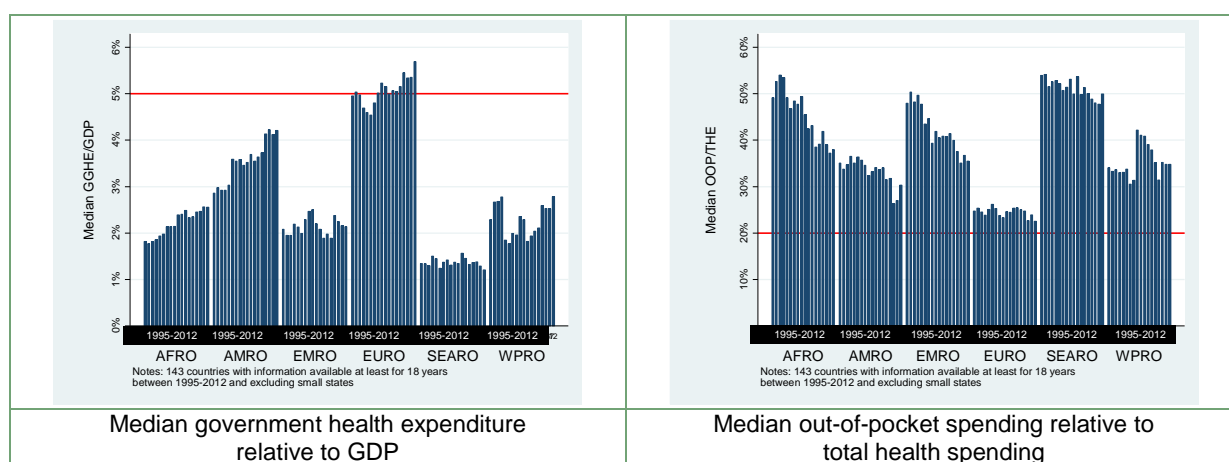
⁴ Defined as those services required to increase coverage on MDGs 1, 4, 5, 6, and 8e to 50%. Costs related to health systems activities or inputs shared across programmes were also estimated.

⁵ Note that since 2013 following a reclassification of GNI by the World Bank, Kyrgyzstan is now categorised as a lower-middle income country.

⁶ Based on the World Bank’s income classification of countries for 2012.

Figure 1 further illustrates this point by showing two trends, one for the median level of GGHE as % of GDP (see left panel) and the other for the median level of OOP as % of THE (right panel) across the period 1995 to 2012⁷. In both panels selected targets are included as horizontal lines; 5% GGHE/GDP, and 20% OOP/THE. A focus on the median allow us to show the performance for half of the countries in each year, whereas the average or mean score can be skewed by one or two countries⁸. In the left panel, the median GGHE/GDP increased in almost all WHO regions (high-income countries are excluded) by almost one percentage point but still remains significantly below 5%; in other words half of the countries increased public spending on health relative to the size of their economies, except in the Eastern Mediterranean and South-East Asia regions.

Figure 1: Trends in public spending on health as %GDP, and direct household contributions relative to total health spending (1995-2012)⁹



Nb¹: Both charts excludes high-income countries

Most importantly, the right-hand side figure shows that the median OOP/THE ratio has decreased in all regions since 1995 except in the WHO European, even in regions where GGHE/GDP has not increased. Three points are worth making based on these findings:

- first, in most regions 50% of countries reduced their reliance on direct payments by households despite being far from spending 5% GGHE/GDP
- secondly, there appears to be scope to reduce reliance on private out-of-pocket payments in the absence of significantly more money for health, as illustrated by the EMRO and SEARO regions
- thirdly, macro analysis of health expenditures has serious limitations, not least understanding simultaneous changes in levels of utilization of health services, something we address in this paper

⁷ Henceforth referred to as GGHE/GDP and OOP/THE.

⁸ A focus on the mean could be influenced by a country outperforming others over a number of years, for example in the case of prolonged economic downturn; whilst interesting in terms of how this affects a country's commitment to health, it is not the focus of this paper.

⁹ Only countries with information available for at least 18 of the 19 years between 1995 and 2012 are included. Countries excluded are Afghanistan (only 12 years of data); Dem. Rep. Congo (11 years); Iraq (11 years); Liberia (11 years); Somalia (7 years); South Soudan (5 years); Timor Leste (14 years). *Small countries are also excluded, i.e. 13 countries in Africa; 15 countries in the Americas; 1 country in the Eastern Mediterranean region; 3 countries in South East Asia and 10 countries in the Western Pacific; WHO regional classification is adopted.*

d) The critical role of public revenue sources for progress towards UHC

Evidence shows that for countries to make progress towards UHC their health system needs to rely predominantly on public revenue sources [7]. By public, we mean those revenue sources which are prepaid, mandatory and pooled; this includes for example both government budgetary allocations as well as mandatory contributions to health insurance schemes, typically in the form of payroll taxes. Recent evidence confirms the importance of fully and systematically executing public resources. Budget allocations to health reflect political commitment, but effectively spending those funds the strength of the health system. In many countries, governments do not fully execute budget allocations for a variety of reasons, including deficiencies in public financial management [2].

Voluntary or private revenue sources tend to contribute little in terms of helping countries move their health systems towards UHC, in particular cash payments at the point of service use, the focus of much political attention in recent years [1, 9]. Voluntary health insurance schemes, whether commercial for-profit or non-profit community-based schemes, do play a role in risk-sharing but tend to reach only a small percentage of a country's population [10]; furthermore, given the nature of these schemes they struggle to maintain financial stability when faced with a population with high levels of unmet needs, and typically exclude either those who need care the most, or relatively expensive health services.

2. Indicators, data and methodology

Given the critical role of public revenues for progress on UHC, our analysis focuses exclusively on the relationship between a country's level of public spending on health and its progress in terms of both service coverage and financial protection. We draw on indicators agreed in the joint UHC monitoring framework [11].

a) Public spending on health

Table 1 shows descriptive statistics for low, middle and high-income countries, for both absolute and relative levels of public spending on health. GGHE/GDP was 3.66% on average between 1995-2012 with a standard deviation of 2.2 percentage points; variance across countries was three times greater than the variance observed within¹⁰ countries over this period. In contrast public spending on health per capita was an average of \$691 with a standard deviation of \$947; here again variation across countries is twice as high across countries as within countries. The high variation in per capita public spending across countries is to be expected given that our sample includes countries at very different levels of economic development.

¹⁰ "Across countries" refers to comparison between different countries. "Within countries" refers to change over time in a single country.

Table 1: Variance decomposition of absolute and relative indicators of public spending on health (1995-2012)¹¹

Public spending on health (GGHE)		Low, middle & high-income countries		Excluding high-income & countries with a population of less than 1.5 million population					
		Mean	Std. dev	Mean	Std. dev	Median 1995	Median 2012	Q1 1995	Q1 2012
as a % of GDP	overall	3.66	2.20	2.86	1.86	2	2.9	1.6	2.2
	between		2.11		1.75				
	within		0.69		0.71				
per capita in US\$	overall	691.06	947.48	183.48	235.75	47.5	156.73	1.82	51
	between		888.53		207.42				
	within		335.53		116.24				

Once we exclude both high-income and small countries¹², variance across countries reduces but remains higher across than within countries for both indicators, with a mean barely 3% for GGHE/GDP, and \$183 in per capita terms. Given the greater variation between countries than within individual countries over time, and the fact that the number of missing values increases with time series data, we focus on a single year in our analysis. We also focus on absolute rather than relative levels of spending; whilst countries at different levels of economic development may have similar levels of GGHE/GDP, their absolute levels of spending differs considerably¹³. Likewise, median GGHE/GDP increased by only one percentage point, from 2% in 1995 to almost 3% in 2012, a period of 19 years.

In contrast, per capita expenditures have almost quadrupled over this period, with the median value increasing from \$47.5 per capita to \$157 per capita, and from \$1.82 to \$51 per capita amongst the lowest 25% spenders (quartile 1 or Q1 in Table 1), with a 0.6 percentage point change in the GGHE/GDP ratio for the latter. This again suggests there is potential for increased spending in real terms, and hence progress on UHC, even if relative levels of public spending change little. We use estimates of public spending on health per capita from 2012 expressed in international dollars (Purchasing Power Parity, or PPP)¹⁴, the latest confirmed and validated data available in WHO's Global Health Expenditure Database (GHED).

¹¹ Notes: Author's own calculations based on an initial sample of 143 countries with information available at least for 18 years between 1995-2012 and excluding small states. The final sample used is 94 countries after excluding those classified as high income in 2012.

¹² See justification in the section on Country Sample.

¹³ We do, however, repeat some of the analysis using GGHE/GDP. See for example Figures 9 and 10 in Annex 4, which rework Figures 3 and 4 in the paper.

¹⁴ National health accounts (NHA) indicators are based on expenditure information collected within an internationally recognized framework. The per capita general government expenditure on health (GGHE) indicator is expressed in PPP international dollars to facilitate international comparisons. It includes not just the resources channelled through government budgets but also the expenditure on health by parastatals, extra-budgetary entities and notably payroll contributions to compulsory or mandatory health insurance schemes. It refers to resources collected and pooled by public agencies, and can also be referred to as "public spending on health". PPP series generated by the 2011 International comparison project (ICP) estimated by the World Bank are used; where these are not available PPPs are estimated by the WHO. Population figures are taken from UN population Division, OECD and EUROSTAT database.

b) Indicators of service coverage

A series of tracer indicators to measure country performance in terms of health service coverage were agreed in the first monitoring report on tracking UHC [11]. Of the eight core tracer indicators we exclude two, *improved water* and *improved sanitation*, given that public spending on health generally does not pay for these interventions. We also exclude antenatal care coverage due to major gaps in official data at the country level. The five indicators used, each of which is measured in terms of the percentage of the target group covered, are:

- Diphtheria, tetanus and pertussis immunization coverage among 1-year-olds (referred to as DPT3)
- Family planning coverage with modern methods (referred to as Family Planning)
- Tuberculosis treatment coverage (referred to as TB)
- Antiretroviral therapy coverage (referred to as ART)
- Live births attended by skilled health personnel - doctors, nurses or midwives - (referred to as SAB)

This set of service coverage indicators focus mostly on priority basic services under the Millennium Development Goals, and hence are most relevant to low and middle-income countries. The latest coverage data for each indicator, 2012 or closest year¹⁵, were taken from WHO's Global Health Observatory (GHO) data repository¹⁶; when values were missing, data from World Bank's World Development Indicator database were used.

c) Indicators of financial protection

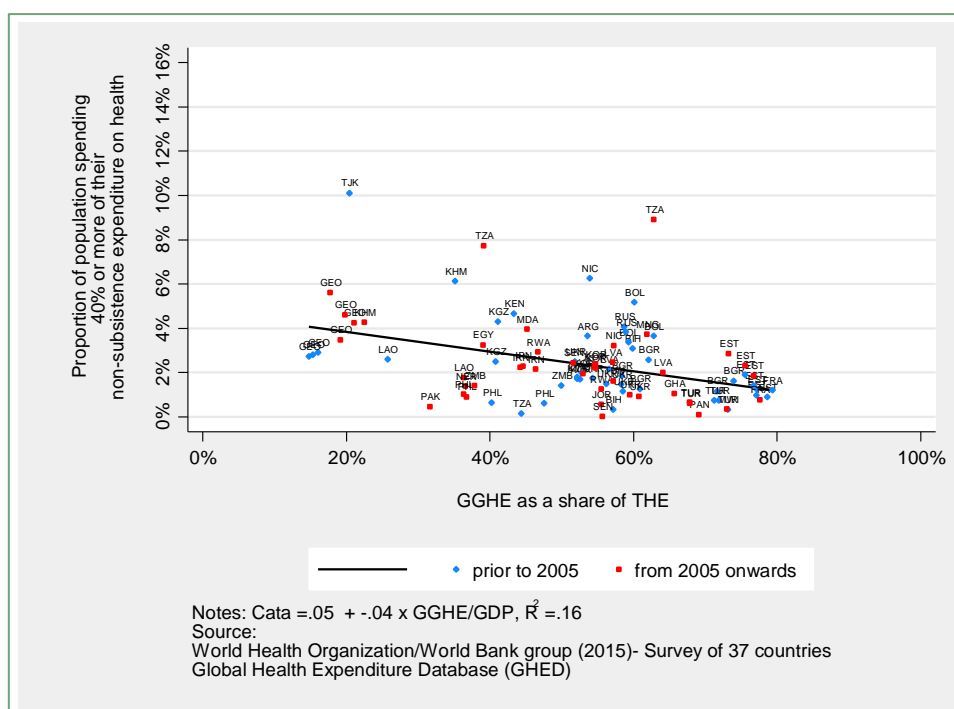
Recent estimates of catastrophic and impoverishing levels of health expenditures are only available for 37 countries. We hence use public expenditure on health as a percentage of total health expenditure (GGHE/THE) as a proxy measure of financial protection, which is in line with the message that moving towards a predominant reliance on public spending is critical for UHC progress [7]. An alternative proxy indicator is out-of-pocket expenditures (OOP) as a percentage of total health expenditure (THE), or rather 1-OOP as %THE; this measure excludes, from our estimate of private spending, expenditures on voluntary health insurance as well as external funding not flowing through government channels, i.e. these would be included in our estimate of public spending. A sensitivity analysis was conducted using this indicator (see Annex 2).

A country's GGHE/THE is, however, only an indirect measure of financial protection as the consequences of paying for health care on household living standards are not captured. However, as Figure 2 shows, there is a negative correlation between GGHE/THE and the incidence of catastrophic expenditures in the 37 countries for which nationally representative data is available between 2002 and 2012; in other words financial protection improves as reliance on public spending increases, suggesting that the indicator is a useful and valid proxy measure.

¹⁵ In four countries the latest data used was for 2009.

¹⁶ For detailed information on how coverage estimates were calculated for each indicator see Reference 10.

Figure 2: Direct and indirect measures of financial protection



d) Methods

We use data envelopment analysis (DEA) which is a linear programming method commonly used to assess efficiency in health systems and many other sectors of the economy [12]. This paper build on methods first used to analyse UHC performance relative to health spending by Moreno-Serra and Smith [13]. DEA determines how well a decision making unit (DMU), in our case a country, converts a set of inputs (public expenditure on health per capita) into a set of outputs (progress on service coverage and financial protection). There are a number of variants to the DEA approach; we use an output-oriented DEA model with variable returns to scale¹⁷.

DEA assesses each countries performance relative to their level of public health spending per capita, and then compares this assessment across a sub-sample of countries with similar levels of inputs. A number of ‘best performing’ countries are identified, and other countries assessed in relation to these countries, with each given a score out of 100%. For instance, a country that has the highest achievement on our performance measures given its level of spending (i.e. all other countries compared with it have lower performance on these indicators) receives a score of 100%. A peer country with a score of 90% is considered to be achieving 90% of the outputs achieved in the best performing country.

To calculate individual country scores, each country is assigned its own unique set of output weights (i.e. weights on service coverage and financial protection indicators)¹⁸; the ratio of the weighted sum of country outputs divided by inputs is calculated and compared across countries. We assign the simple constraint that each performance indicator must be given a weight greater than 0, so that progress on each of the indicators must be taken into account;

¹⁷ An input-based approach can also be used; this would analyse variation in inputs for a given level of outputs.

¹⁸ Because we use only one input in each model, the input weights are the same for all countries (i.e. equal to 1).

otherwise indicators on which countries perform badly could essentially be ignored by the DEA model. We use the Efficiency Measurement System (EMS) software. For further discussion on methods see Annex 3.

e) Country sample

In a similar way that we remove progress on water and sanitation from our analysis due to a lack of clear causal relationship between inputs and outputs, we also remove 55 countries classified as high-income in 2012 out of the original sample of 191 countries. The reason is that the indicators we use reflect priority services in low and middle-income countries, on which many significant coverage challenges remain. In all high-income countries there is near to full coverage on these indicators, and hence a different set of indicators would be more appropriate for such analysis.

Given that we conduct a cross-sectional analysis for a single year, we remove countries classified as small states¹⁹ by the World Bank, due to the fact that both spending and performance indicators in smaller populations can vary significantly from year to year due to their greater exposure to international trade, economic shocks and income volatility²⁰; this could have a significant impact on the results of a DEA using single year cross-sectional data. We hence remove a further 35 countries from our analysis²¹. However, we also conduct a sensitivity analysis using averages for a five year period (see Annex 2), which shows broadly similar results. Missing country values for the inputs or output variables were also eliminated (18 countries had incomplete data)²² leaving a final sample of 83 low and middle-income countries (see Annex 5); see Annex 6 for limitations of the analysis.

3. Results

a) Descriptive analysis

Figure 3 shows descriptive statistics for both service coverage and financial protection, in which the 83 countries are categorised into quintiles based on their level of per capita public spending on health: Q1 represents the lowest spending countries and Q5 the highest²³. The upper panel shows performance for countries, again categorised by spending quintile and using boxplots, on the five services combined (right side in black), and financial protection (left side in green); the more compact the box the less dispersion there is across the middle

¹⁹ The World Bank defines small countries as those with a population of 1.5 million or less.

²⁰ World Bank (2015). Small States.

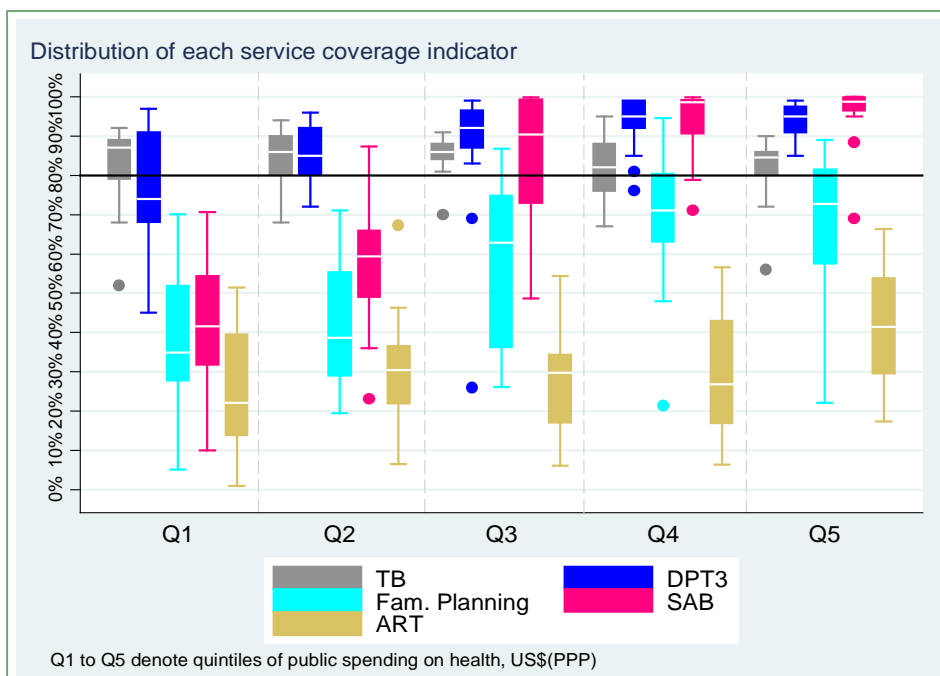
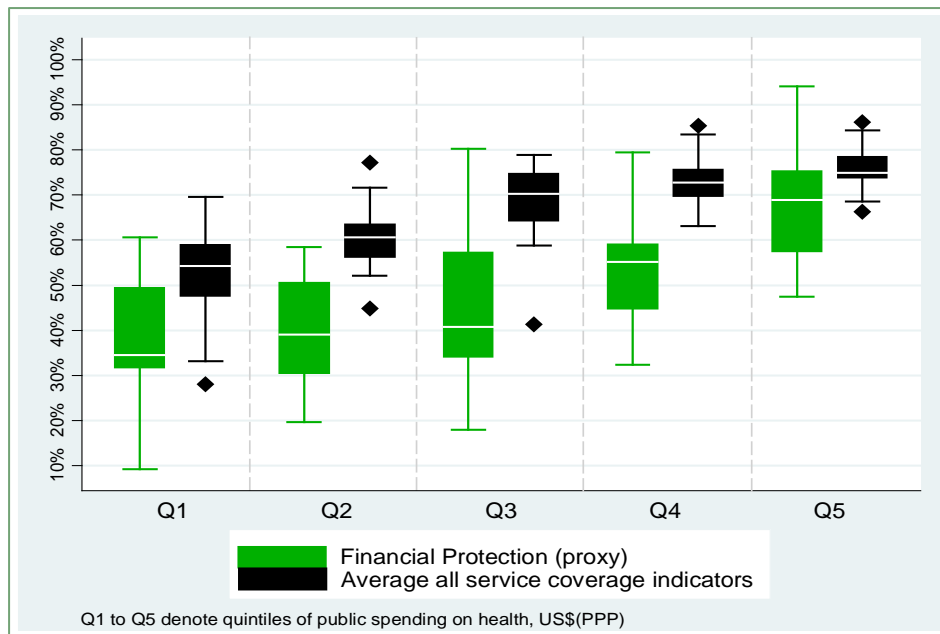
²¹ Forty-one countries in our sample were small states; six were already removed as high-income countries.

²² Angola; D.R. Congo; Hungary; Iraq; Jordan; D.P. Korea; Lebanon; Libya; Papua New Guinea; Somalia; South Africa; Syrian Arab Republic; Turkmenistan; Uganda; Uzbekistan; Yemen; Zambia and Zimbabwe.

²³ Quintile ranges for levels of public spending on health per capita are: Q1 = <\$37.5; Q2 = \$38.20 to \$59.60; Q3 = \$60.90 to \$198.10; Q4 = \$207.60 and \$500.30; Q5 = >\$520.50.

50% of countries²⁴. Average service coverage increases as countries spend more; variation across countries also systematically falls i.e. performance converges. In contrast, such clear convergence is not observed for financial protection; whilst the distribution across countries becomes less skewed²⁵, performance remains as dispersed amongst middle quintile spenders as it does amongst the lowest spenders (quintile 1), and reduces only marginally in the highest spending countries (quintile 5).

Figure 3: Descriptive statistics (inputs and outputs) by public spending on health quintile¹⁷



²⁴ Boxplots emphasize trends in median performance; the median point is the line which divides boxes into two parts. Dispersion in performance is shown by the box, the upper limit of which denotes performance at the 75% quartile, the lower limit the performance at the 25% quartile.

²⁵ Indicated by the median line which moves towards the centre of boxes across quintiles.

The data suggests that when low-spending countries start to increase public spending on health, this translates first into greater use of essential health services, than financial protection.

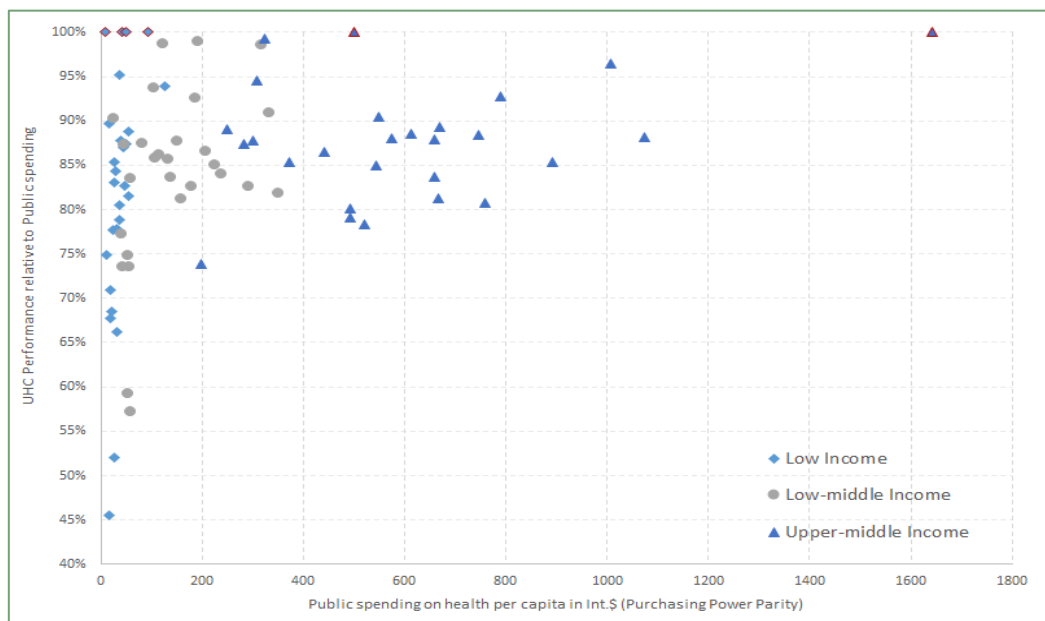
The lower panel of Figure 3 show boxplots for each individual service, with the horizontal line at 80% representing agreed coverage targets. There is relatively good performance across all spending quintiles in terms of DPT3 and TB coverage, the latter surpassing the 80% coverage target [11] in half of our sample countries. Again, in half of countries within each of the spending quintiles, DPT3 coverage rates are above 80% and even above 70% for the lowest spenders.

What is particularly noticeable in Figure 3 (lower panel) is that increasing levels of public spending strongly correlate with better performance on SAB, with the median increasing from barely 40% in the lowest quintile (Q1) to almost 100% in the top quintile. Convergence in family planning performance also increases with spending, but less so than for SAB. ART coverage is low across all levels of spending, with little in terms of convergence in performance to report. These differences in the scope of progress at different levels of public spending are important for the DEA analysis.

b) Main DEA model

Figure 4 presents the results of the DEA model, with a score for each country which is also identified in terms of its income-category. The DEA model identifies a number of ‘best performing’ countries that achieve greater performance relative to their level of spending than other countries with which they are compared (peer countries); these countries receive a score of 100%. It is important to note that a score of 100% does not imply these countries have achieved or are even close to achieving UHC, but simply that they outperform countries with similar levels of public spending on health.

Figure 4: UHC performance relative to public spending in 83 low and middle-income countries



Six “best performer” countries are identified in our analysis: Myanmar, Cambodia, Malawi, Rwanda, Thailand and Cuba, discussed in more detail later in this paper. Perhaps the most striking observation from Figure 4 is the very large variation in performance at low levels of public spending represented by a high dispersion on the y-axis, with increasing convergence (or lower variation across the y-axis) as public spending increases. We measure this variation more systematically by looking at the standard deviation of DEA scores within spending quintiles (see Table 2).

Table 2: Variation in relative performance at low levels of public spending on health

Quintile	Level of public spending on health per capita	Number countries	Std. dev. of DEA scores	Mean DEA score	Min DEA score
1	GGHE less than \$37.50	17	14.4%	77.0%	45.5%
2	GGHE between \$38.20 and \$59.60	17	9.9%	83.0%	59.2%
3	GGHE between \$60.90 and \$198.10	16	10.7%	86.8%	57.1%
4	GGHE between \$207.60 and \$500.30	17	6.5%	88.1%	79.1%
5	GGHE higher than \$520.50	16	5.6%	87.8%	78.3%

Those countries in the lowest spending quintile i.e. below \$PPP 37.50 per capita public spending on health have by far the greatest variation in DEA scores at 14.4%, with quintiles 2 and 3 showing much lower variation at around 10%; the lowest variation is in the highest spending quintiles 4 and 5. UHC performance improves, and variation in performance across countries falls, as absolute levels of public spending on health increase. We also conduct the analysis using country income groupings which shows a similar trend (see Table 7 in Annex 4).

In order to understand what drives the observed convergence in UHC progress relative to public spending on health, we refer back to Figure 3 which shows that this trend is driven primarily by improvements in service coverage rather than financial protection. Even at higher levels of public spending i.e. in Q3, Q4 and Q5, whilst financial protection improves on average, there remains considerable variation across countries in terms of how they perform.

c) Best-performing countries

The six countries identified as showing the best progress for their given level of per capita public spending on health are Myanmar, Cambodia, Malawi, Rwanda, Thailand and Cuba. The latter three are widely acknowledged in the literature as good performers, Cuba since being identified as a country providing good health at low cost in the 1980s [14], and Thailand for its expansion of service coverage and range of reforms including the Universal Coverage Scheme in 2004 [15-17]; both these countries are upper-middle income and score well across most of the progress indicators. Rwanda is a low-income country, known for its establishment of almost universal population coverage through highly organised mutuelles [18]; in the DEA analysis Rwanda does well on most indicators, although worse than Cuba and Thailand on family planning and skilled attendance at birth coverage, two indicators which appear to be particularly sensitive to absolute levels of public spending.

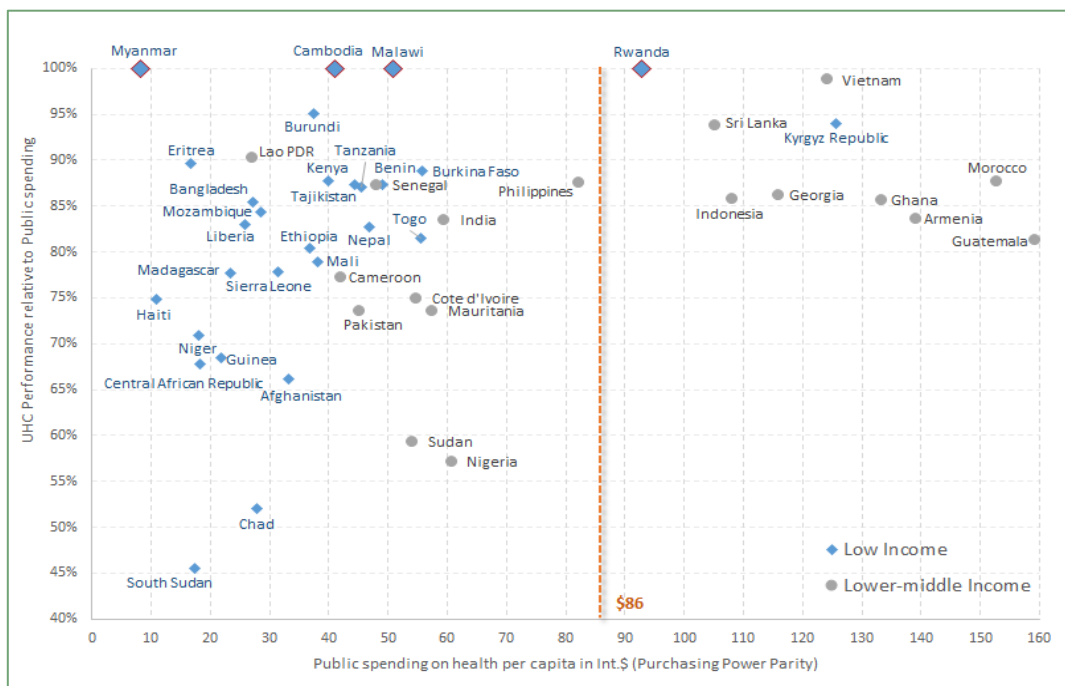
The other three countries are low-income, like Rwanda, but spend considerably less in absolute terms. Cambodia’s introduction of health equity funds led to a reduction in out-of-

pocket spending by 26% [19] at the same time as a remarkable increase in the utilization of child and maternal health services, in part due to reforms such as performance-based incentive payments to midwives [20] and the use of vouchers to promote maternity care [21]. Whilst Cambodia performs particularly well across most of the service indicators, it still does poorly on financial protection despite recent improvements. For Malawi and Myanmar progress is again driven mostly by good service coverage (apart from ART), rather than financial protection, the latter being a particular challenge in Myanmar.

d) Variation in UHC progress at low levels of public spending

The large variation in performance at low levels of public spending suggests that there is significant room for improvement in the way that money is spent and services are delivered, which in turn could impact significantly in terms of UHC. This point is of particular interest given that the greatest levels of unmet health needs are generally in the poorest countries; furthermore it supports the assertion that even at levels of public spending significantly below the widely referred to spending targets summarised at the beginning of this paper, UHC progress should be possible. We look more closely at countries with low levels of public spending on health in Figure 5, which presents the main DEA model results for countries spending below \$160 per capita.

Figure 5: UHC performance in countries with public spending on health below \$160 pc



Focusing on two of the best performing countries which spend below \$86 per capita, Cambodia and Malawi, we look more closely at the significant difference in performance between these countries, and selected peer countries in the DEA.

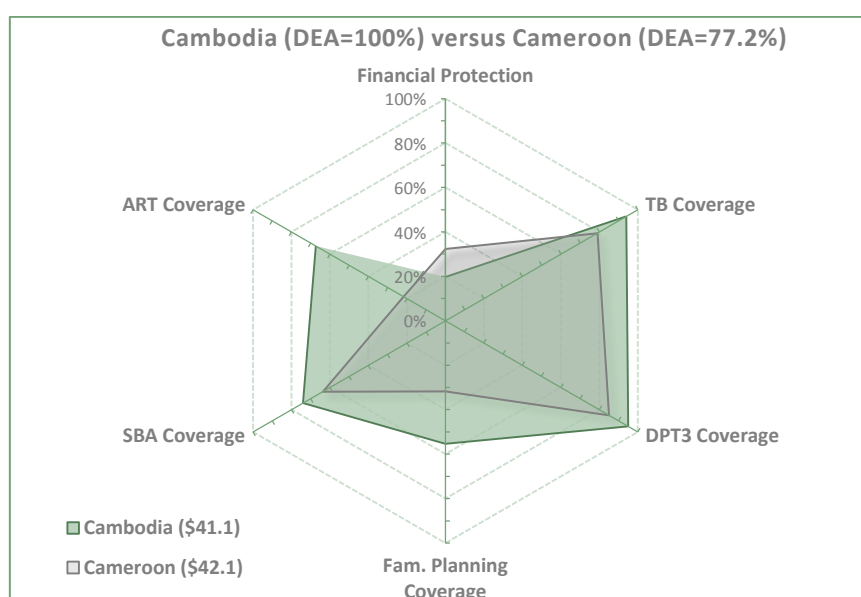
Cambodia: Table 3 shows DEA scores for a selection of the 24 countries for which Cambodia was a peer in the analysis.

Table 3: Cambodia and selected DEA peers

DEA peer countries	DEA Score	GGHE per capita	GGHE % GDP
Sierra Leone	77.8%	31.4	1.95%
Ethiopia	80.5%	36.8	2.97%
Kenya	87.8%	39.9	1.82%
Cambodia	100%	41.1	1.45%
Cameroon	77.2%	42.1	1.62%
Tanzania	87.0%	45.5	2.78%
Senegal	87.2%	48.2	2.18%

We focus even more specifically, using a spider chart (see Figure 6), to compare performance between Cambodia and Cameroon which have almost identical levels of public spending on health per capita, PPP\$ 41.10 and PPP\$ 42.10 respectively, but significantly different performance. Both countries spend less than half of the US\$86 per capita spending estimate, but Cameroon achieves significantly less in terms of UHC progress than Cambodia as shown its lower DEA score (77.2% compared with 100%). Both countries perform poorly in terms of financial protection overall, perhaps not surprising given the very low level of absolute spending in both, but Cambodia performs better on all of the service coverage indicators in particular family planning and ART coverage.

Figure 6: Comparison of UHC progress in Cambodia and Cameroon



At this stage we are interested in looking at the main differences in performance, and asking questions which merit further analysis in terms of the way in which the country's health systems are organised. Clearly, however a wide-range of non-health system factors could at least in part explain such differences, such as levels of education and cultural attitudes towards health-seeking behaviour, as well as population density which is much greater in Cambodia may also explain some of the variation [22]. Interestingly, in addition to being richer, Cameroon actually gives a higher priority to health than Cambodia in terms of government allocations, something which illustrates broader fiscal capacity and the effect of

using PPP\$, given that public spending per capita on health is almost identical in the two countries (see Table 4).

Table 4: Selected indicators for Cambodia and Cameroon

Country	GGHE/GDP	Priority: GGHE/GGE	Income level: GNI per capita	Population size (millions of hab.)	Population density (people per sq. km of land area)	Education: Mean years of schooling (of adults)
Cambodia (LIC)	1.45%	6.7%	880	14.8	84	5.8
Cameroon (LMIC)	1.62%	8.5%	1,230	21.7	46	5.9

The best performing country for its level of spending, Cambodia has undergone a number of health sector reforms in the past decade, as noted earlier. Cameroon has looked to cover its population through its “Strategic Plan for the Promotion and the Development of Mutual Health Insurance (2005–2015)”, but limited progress has been made with only one percent of the population covered through these schemes in 2010. In 2013, Cameroon also introduced programme budgeting to improve public expenditure management which has led to low budget execution and poor strategic allocation of resources in the health sector. Whilst enjoying one of the highest densities of nurses and doctors in Sub-Saharan Africa, they are heavily concentrated in urban areas in Cameroon; the country is now starting to pilot voucher-type schemes to improve maternal health, and results-based financing [23]. Clearly a more systematic comparison of how the two health systems are organised is required to understand these differences in performance on core essential health services in more detail.

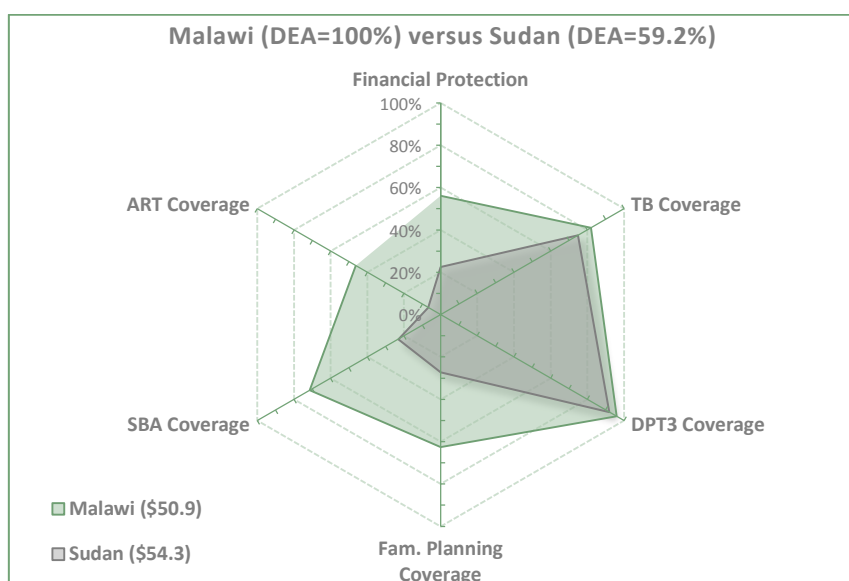
Malawi: Table 5 shows DEA scores for a selection of the 15 countries for which Malawi, another best-performer, was a peer in the analysis.

Table 5: Malawi and selected peers

DEA peer countries	DEA Score	GGHE per capita	GGHE % GDP
Tajikistan	87.3%	41.1	1.88%
Tanzania	87.0%	45.5	2.78%
Senegal	87.2%	48.2	2.18%
Malawi	100%	50.9	5.16%
Sudan	59.2%	54.3	1.50%
India	83.5%	59.6	1.28%
Philippines	87.4%	82.3	1.35%

Figure 7 compares Malawi with Sudan, which has a very similar level of spending, PPP\$ 50.9 compared with PPP\$ 54.3 but very different performance; Sudan achieves a DEA score of 59.2%.

Figure 7: Comparison of UHC progress in Malawi and Sudan



Malawi performs dramatically better on ART, SAB and family planning coverage, with a similarly high level for DPT3 and TB treatment coverage. Despite a slightly lower level of public spending in absolute terms, and with 70% of total health expenditures coming from external sources which may have some influence on the quality of spending (an important issue beyond the scope of this paper), Malawi performs significantly better in terms of financial protection.

Table 6 shows selected indicators for both countries; Malawi has a much lower GNI per capita than Sudan, and only achieves a similar level of public spending by giving a far higher priority to health. With lower levels of education, Sudan is also a far larger and less densely populated country with many remote communities.

Table 6: Selected indicators for Malawi and Sudan

Country	GGHE/GDP	Priority: GGHE/GGE	Income level: GNI per capita	Population size (millions of hab.)	Population density (people per sq. km of land area)	Education: Mean years of schooling (of adults)
Malawi (LIC)	5.16%	22.1%	320	15.7	167	4.2
Sudan (LMIC)	1.50%	11.1%	1,650	37.7	20	3.1

In terms of health system organisation, Malawi has invested significantly in health systems strengthening activities in recent years, and increasingly focuses its public resources on a clearly defined essential health package which can be accessed free at the point of service [24, 25]. The provision of services and management of funds are decentralised with districts having extensive responsibility. Interestingly, Malawi allocates significant public resources to cross-cutting health systems activities e.g. management of medical equipment and supply chain.

Sudan has a long-established federal health insurance system although its population reach has been limited, and is only recently looking to establish a set of essential health services

for the entire population [26]. Again, this analysis aims to service as an initial investigation of the data, with a more systematic comparison of how the two health systems are organised, as well as other influential environmental factors, required to understand the differences in performance in more detail.

4. Conclusions

This paper was motivated by a desire to bring greater perspective to the literature on health expenditure targets, which are limited in terms of providing country policy makers with useful analysis. We systematically explore the relationship between levels of public spending on health, and performance on a number of agreed indicators of UHC progress; we use both descriptive analysis and data envelopment analysis.

There is very high variation in how countries perform, at low levels of public spending (below PPP\$40 per capita). As spending increases, there is convergence in UHC performance across countries; interestingly, increased public spending quickly translates into improved service coverage (between PPP\$40-60 per capita), but not financial coverage which only improves significantly when public spending is greater than PPP\$200 per capita.

Overall the analysis suggests significant scope for improvements in how public funds are spent, particularly at low levels. Poor performance is observed across the sample on family planning with modern methods and coverage of anti-retroviral treatment. Further analysis is required to understand and explain why low-spending countries with similar levels of public spending have significant variations in performance; clearly both non-health systems factors such as population density, as well factors relating to how health systems are organised and how money is spent, will be important.

One issue which merits further investigation is the role of external funding; several countries in our sample have a high reliance on external funding which in most cases is focused on the services we use as UHC tracer interventions. Whilst we capture the majority of external funding in our measure of public spending (GGHE), we do not capture potential effects on the quality of spending. Indeed the quality of public spending, whether external or domestic, is relevant for all country and merits deeper investigation.

Finally, this analysis clearly demonstrates that absolute levels of public spending on health are critical for progress on UHC, but that at any given level of spending, but particularly at low levels, there is significant scope for UHC progress through greater efficiency in how money is spent.

Annex 1: Summary of international health expenditure benchmarks and targets

YEAR	SOURCE	HEALTH EXPENDITURE TARGETS			
		Absolute terms (per capita)	As a share of GDP	As a share of GGE	OOPs/THE
2014	McIntyre et al. [4]	\$86 GGHE in LIC	5% GGHE		
	WHO/PAHO [27]		6% GGHE		
	HTGSD [28]		5% GGHE		
2010	HLTF, WHO and partners [29] [30]	\$60 THE LIC by 2020			
	WHO [1] [5]		5%-6% GGHE		15%–20%
	WHO/EMRO [31]			GGHE of 8%	
2009	High Level Task Force [6]	\$54 THE LIC by 2015			
	WHO/WPRO SEARO [32]		4%-5% THE		30%–40%
	WHO/PAHO [33]		6% GGHE		
2001	Abuja Declaration [34]			GGHE of 15%	
	Commission on Macroeconomic and Health [35]	\$34 and \$38 LIC by 2007 and 2015*			
	WHO, Evans et al. [36]	\$80 THE per capita			
2000	WHO, Evans et al. [37]	\$60 THE per capita			
1993	World Bank [38]	\$12 and \$22 per capita LIC, LMIC*			
1980s	WHO [39] [40]		5% THE/GNP		

Note: LIC: Low-income countries; LMIC: Lower-middle income countries.

* Related to the minimum package required and which should be achieved by joint government, donor agencies and patients efforts.

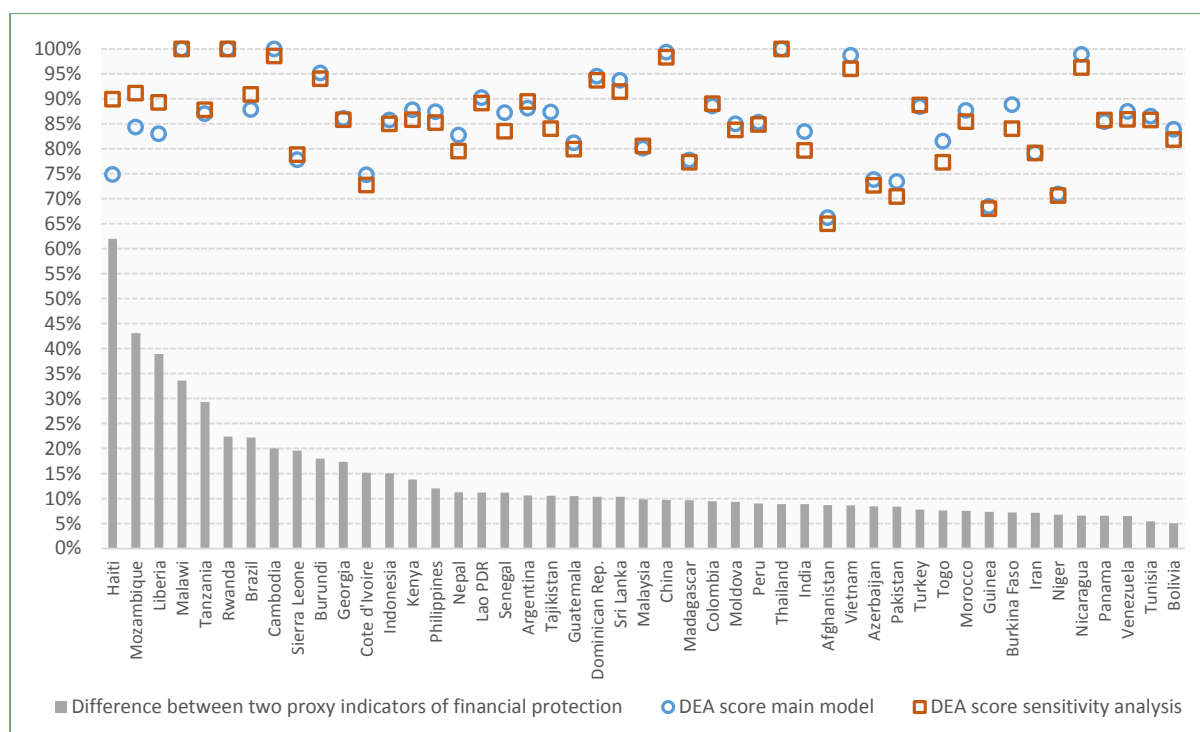
Annex 2: Sensitivity analysis

Three sensitivity analyses were performed:

- **first**, we replace the proxy indicator for financial protection by an alternative based on 1-(OOPs as %THE)
- **second**, we replace all indicator scores for 2012 with average scores for the 5-year period 2008-2012.
- **third**, we remove all imputed indicator scores which further restricts our sample to 60 countries.

Alternative indicator of financial protection: we re-run the main model replace our proxy for financial protection (GGHE/THE) with the indicator (1-OOP/THE) as per the discussion in Section 3: *Indicators of financial protection*. The results remain similar; five of the six “best performer” countries in the main model remain, with Cambodia excluded, albeit still with a very high DEA score. Overall across the sample, DEA scores do not change more than 1.2% from the main model. Only where a country has high expenditures on voluntary health insurance and or external funding not flowing through government channels would we expect significant change; Figure 8 shows countries where these flows represent more than 5% of THE (see grey bar), and hence the use of this alternative indicator results in a significantly different indicator score; subsequent DEA scores under the main and alternative model are plotted. The only country’s where the DEA score differs significantly are Haiti, Mozambique and Liberia, and in each case improve as a result.

Figure 8: Impact on DEA scores of using alternative proxy measure of financial protection



Longitudinal analysis: We ran the DEA model using time series averages across a period of five years (2008-2012) i.e. averages for input and output values were calculated for the 83 countries in question. Although complete data was available across the five years for the health spending indicator, this was not the case for all output values. We hence calculated averages using whatever data was available in service coverage indicators. The DEA model still returns six countries as best performers, namely Myanmar, Cambodia, Malawi, China, Thailand and Cuba. The only change was that China replaces Rwanda, which still scores highly (98%); the other five countries remaining the same.

Remove of imputed data: out of the sample of 83 countries 23 countries contain estimated data in 2012. We conducted sensitivity analysis by removing these countries leaving a sample of 60 countries, with Myanmar and Rwanda, two of the best performer in the main model removed from the sample with Haiti and Vietnam now shown as best performers.

Across these three sensitivity analyses, three of the six countries identified in the main model as “best performers” for their level of public spending remain the same, namely Malawi, Thailand and Cuba.

Annex 3: Methodological approach to the analysis

Unlike parametric approaches used to measure efficiency, DEA does not require any assumptions to be made regarding the functional form of the frontier, which is essentially made up of those DMUs/countries with the best outputs/performance for a given of inputs. In our case outputs are indicators of UHC progress and inputs are public spending on health per capita. DEA is however more sensitive to outliers as it produces a deterministic frontier which does not distinguish noise from efficiency scores, nor hypothesis testing or model fit.

In DEA, a DMU is assessed based on the ratio of a weighted sum of its outputs divided by a weighted sum of its inputs. To do this, each DMU is assigned its own unique set of input and output weights, which cast it in the best possible light [41]. While this flexibility in determining weights is an appealing characteristic of DEA, one potential drawback is that if a DMU performs extremely poorly on some outputs but very well on others, the DEA program may assign a 0% weight to the poorly produced outputs (or alternatively, assign a 100% weight to a very high performing output). A 0% weight would imply that said output has no intrinsic value to the DMU (i.e. it is dropped from the model), which in our analysis is not acceptable given our concern with country performance on both service coverage and financial protection. Furthermore, a number of countries score poorly on service coverage but well on financial protection, which may be due to non-use of health services and unmet health needs.

Various authors have suggested ways of imposing restrictions on weights in DEA [42]. In this study we assign the simple constraint that each UHC performance indicator be given a weight greater than 0. This assures that all indicators are evaluated for all DMUs, while still permitting a considerable degree of flexibility in the weights. However we also run a DEA model with no weight restrictions and find similarities in the sense that the most efficient countries remain the same.

Annex 4: Additional analysis

Table 7: Descriptive statistics by country income group of score related to UHC performance relative to levels of public spending on health

UHC performance relative to levels of public spending on health	Number countries	Mean DEA score	Std. dev. of DEA scores	Min DEA score	Max DEA score
Low income countries	28	82.22%	13.71%	45.48%	100%
Lower-middle income countries	28	83.53%	9.92%	57.13%	98.87%
Upper-middle income countries	27	87.50%	6.80%	73.83%	100%

Figure 9: Coverage progress relative to public spending on health per capita

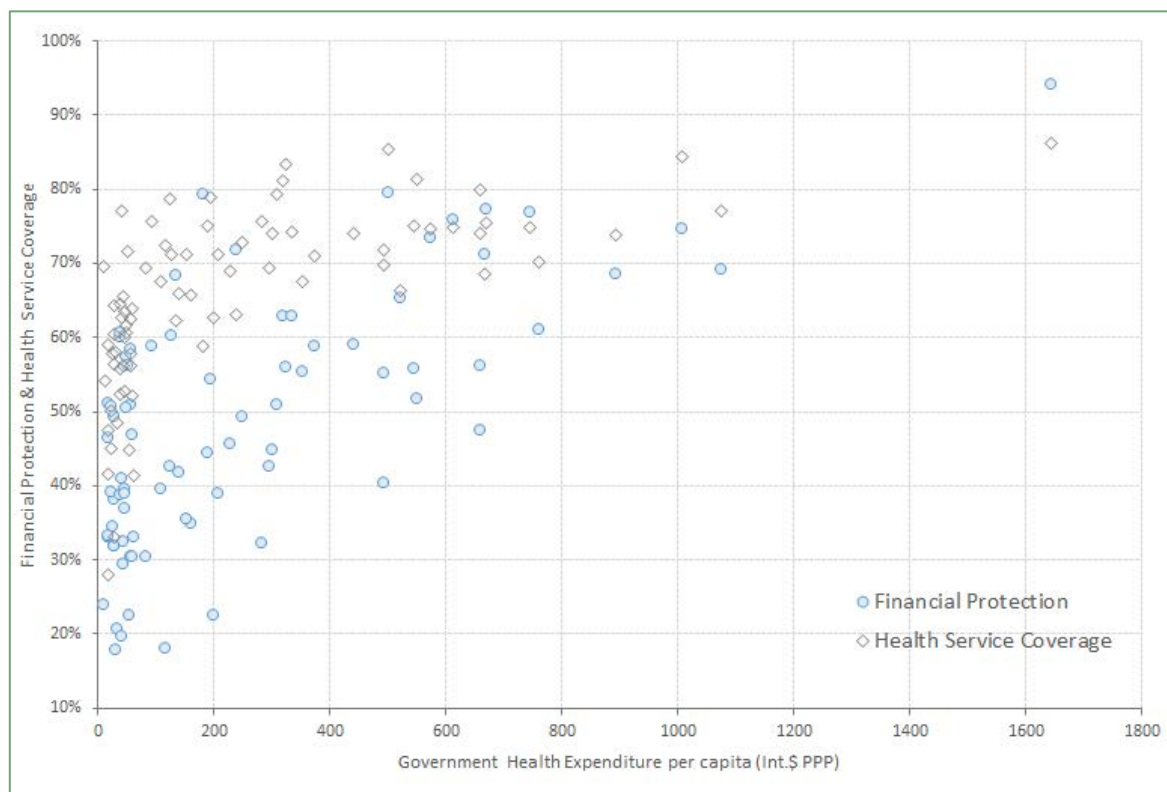


Figure 10: Public spending on health as % GDP by quintile relative to coverage performance

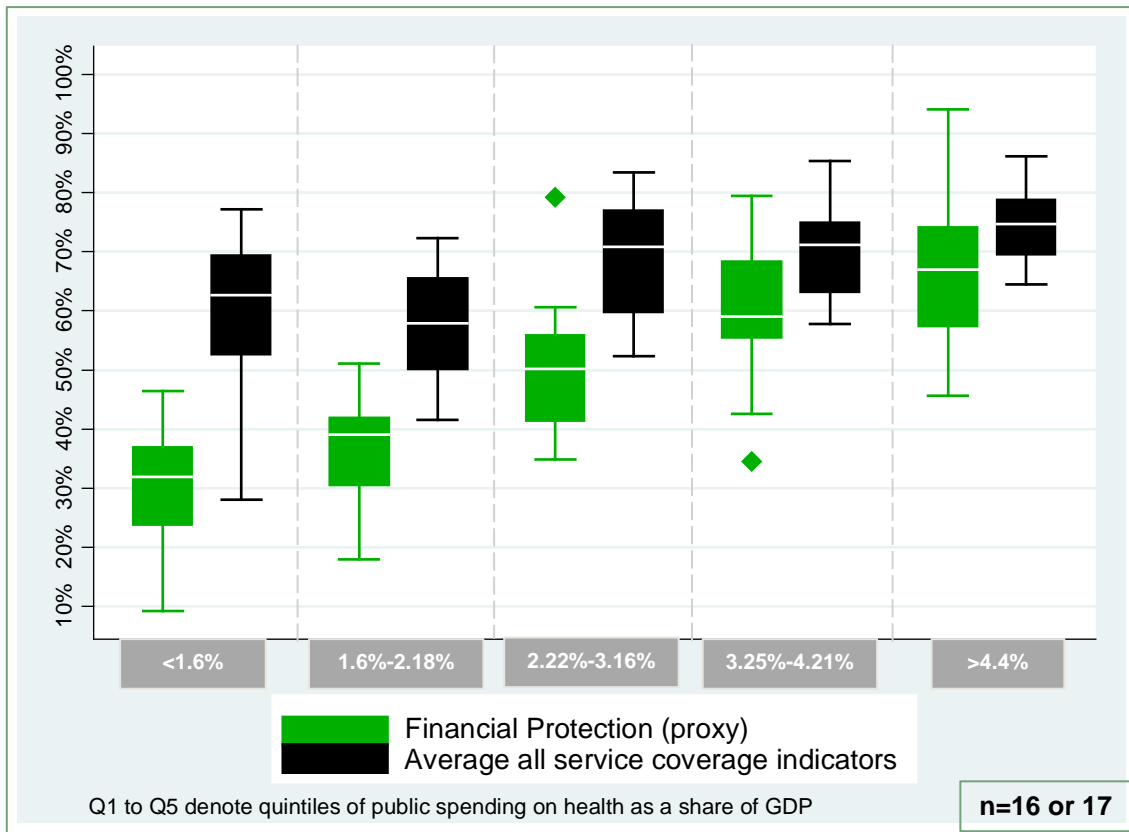
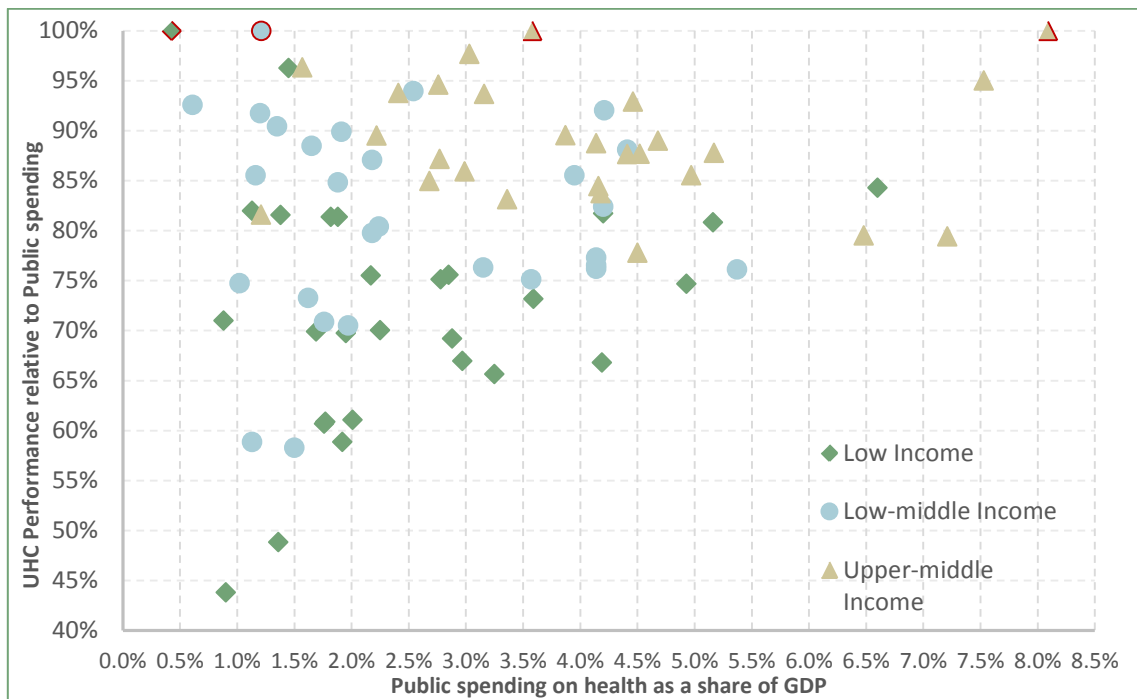


Figure 11: UHC performance relative to public spending on health as %GDP



Annex 5: List of sample countries with official indicator values

	Countries	DEA Score	Public spending on health per capita in Int.\$ (PPP) ²⁶	Financial protection (proxy) ²⁷	TB coverage ²⁸	DPT3 coverage ²⁹	Fam. planning coverage ³⁰	SBA coverage ³¹	ART coverage ³²
LOW-INCOME COUNTRIES									
1	Afghanistan	66.2%	33.10	20.8%	88.0%	71.0%	39.9%	38.6%	4.7%
2	Bangladesh	85.4%	27.20	31.9%	92.0%	97.0%	70.1%	31.7%	11.3%
3	Benin	87.4%	48.95	57.4%	90.0%	76.0%	19.4%	84.1%	33.6%
4	Burkina Faso	88.8%	55.76	58.5%	80.0%	90.0%	38.7%	65.9%	37.4%
5	Burundi	95.1%	37.53	60.1%	89.0%	96.0%	37.1%	60.3%	39.7%
6	Cambodia	100%	41.12	19.7%	94.0%	95.0%	55.4%	74.0%	67.3%
7	Central African Republic	67.8%	18.22	51.1%	68.0%	47.0%	25.0%	53.8%	13.9%
8	Chad	52.0%	27.82	38.1%	69.0%	45.0%	8.5%	22.7%	20.5%
9	Eritrea	89.7%	16.61	46.5%	87.0%	94.0%	28.1%	34.1%	51.5%
10	Ethiopia	80.4%	36.80	60.6%	91.0%	69.0%	51.9%	10.0%	40.0%
11	Guinea	68.5%	21.88	39.2%	82.0%	63.0%	12.5%	45.3%	22.1%
12	Haiti	74.9%	10.81	9.2%	81.0%	68.0%	45.4%	37.3%	39.4%
13	Kenya	87.8%	39.90	40.9%	86.0%	83.0%	60.0%	43.8%	41.0%
14	Kyrgyz Republic	93.9%	125.54	60.2%	84.0%	96.0%	63.1%	99.1%	13.4%
15	Liberia	83.0%	25.85	34.5%	79.0%	93.0%	34.8%	61.1%	21.2%
16	Madagascar	77.7%	23.44	50.7%	82.0%	70.0%	53.5%	43.9%	1.0%
17	Malawi	100%	50.93	56.1%	82.0%	96.0%	62.6%	71.4%	46.3%
18	Mali	78.9%	38.22	38.8%	93.0%	74.0%	25.8%	56.1%	29.6%
19	Mozambique	84.3%	28.41	49.4%	87.0%	76.0%	32.5%	54.3%	31.8%
20	Myanmar	100%	8.32	23.9%	89.0%	84.0%	69.2%	70.6%	35.2%
21	Nepal	82.7%	46.78	39.5%	91.0%	90.0%	60.3%	36.0%	22.9%
22	Niger	70.9%	18.04	33.1%	77.0%	74.0%	27.7%	29.3%	29.8%
23	Rwanda	100%	92.71	58.8%	84.0%	98.0%	61.0%	69.0%	66.3%
24	Sierra Leone	77.8%	31.38	17.9%	90.0%	91.0%	30.4%	62.5%	15.9%
25	South Sudan	45.5%	17.37	33.3%	52.0%	59.0%	5.1%	19.4%	4.5%
26	Tajikistan	87.3%	44.33	29.4%	83.0%	94.0%	52.7%	87.4%	10.1%
27	Tanzania	87.0%	45.54	39.1%	90.0%	92.0%	49.7%	48.9%	36.6%
28	Togo	81.5%	55.52	50.9%	86.0%	84.0%	29.0%	59.4%	30.5%

²⁶ Global Health Expenditure Database (GHED), 2012. <http://apps.who.int/nha/database/Select/Indicators/en>.

²⁷ Global Health Expenditure Database (GHED), 2012. <http://apps.who.int/nha/database/Select/Indicators/en>.

²⁸ Global Health Observatory (GHO) data repository, 2012 or nearest year.

<http://apps.who.int/gho/data/node.main.1335?lang=en>

²⁹ GHO data repository, 2012 or nearest year. <http://apps.who.int/gho/data/node.main.1335?lang=en>

³⁰ World Bank & GHO, 2012 or nearest year. <http://databank.worldbank.org/data/reports.aspx?source=health-nutrition-and-population-statistics> & <http://apps.who.int/gho/data/view.main.94330>

³¹ World Bank, 2012 or nearest year. <http://databank.worldbank.org/data/reports.aspx?source=health-nutrition-and-population-statistics>

³² World Bank & GHO, 2012 or nearest year. <http://databank.worldbank.org/data/reports.aspx?source=health-nutrition-and-population-statistics> & <http://apps.who.int/gho/data/view.main.23300?lang=en>

	Countries	DEA Score	Public spending on health per capita in Int.\$ (PPP) ²⁶	Financial protection (proxy) ²⁷	TB coverage ²⁸	DPT3 coverage ²⁹	Fam. planning coverage ³⁰	SBA coverage ³¹	ART coverage ³²
LOWER-MIDDLE INCOME COUNTRIES									
29	Armenia	83.6%	139.14	41.9%	81.0%	95.0%	38.7%	99.5%	15.8%
30	Bolivia	83.9%	238.23	71.8%	84.0%	93.0%	48.0%	71.1%	19.5%
31	Cameroon	77.2%	42.13	32.4%	79.0%	85.0%	31.7%	63.6%	21.8%
32	Congo, Rep.	82.6%	180.45	79.2%	70.0%	69.0%	33.0%	93.6%	28.4%
33	Cote d'Ivoire	74.8%	54.97	30.4%	79.0%	82.0%	30.5%	59.4%	30.4%
34	Egypt, Arab Rep.	86.5%	207.62	39.0%	88.0%	93.0%	80.4%	78.9%	15.7%
35	El Salvador	98.5%	318.81	62.8%	93.0%	92.0%	77.4%	95.5%	47.5%
36	Georgia	86.1%	116.00	18.0%	85.0%	92.0%	51.9%	99.8%	32.9%
37	Ghana	85.6%	133.41	68.3%	84.0%	92.0%	33.5%	68.4%	33.8%
38	Guatemala	81.2%	159.40	34.9%	88.0%	96.0%	62.5%	51.5%	31.0%
39	Honduras	92.5%	188.78	44.4%	89.0%	88.0%	75.8%	82.9%	39.1%
40	India	83.5%	59.56	30.5%	88.0%	72.0%	71.1%	52.3%	35.9%
41	Indonesia	85.8%	108.26	39.6%	86.0%	83.0%	79.3%	83.1%	6.2%
42	Lao PDR	90.2%	27.21	31.8%	90.0%	79.0%	62.8%	41.5%	47.8%
43	Mauritania	73.5%	57.57	47.0%	68.0%	80.0%	25.7%	65.1%	21.5%
44	Moldova	85.0%	226.92	45.6%	76.0%	92.0%	61.2%	99.2%	16.8%
45	Mongolia	90.9%	333.25	62.8%	88.0%	99.0%	71.1%	98.8%	14.5%
46	Morocco	87.6%	152.87	35.5%	89.0%	99.0%	73.7%	73.6%	21.1%
47	Nicaragua	98.9%	192.73	54.3%	87.0%	98.0%	86.8%	88.0%	34.8%
48	Nigeria	57.1%	60.91	33.2%	86.0%	26.0%	26.2%	48.7%	19.8%
49	Pakistan	73.4%	45.18	36.9%	91.0%	72.0%	45.1%	49.0%	6.5%
50	Paraguay	82.6%	294.11	42.6%	70.0%	87.0%	80.8%	81.9%	26.8%
51	Philippines	87.4%	82.28	30.4%	88.0%	86.0%	51.4%	72.2%	49.2%
52	Senegal	87.2%	48.21	50.6%	84.0%	91.0%	33.1%	65.1%	35.4%
53	Sri Lanka	93.7%	105.40	39.1%	86.0%	99.0%	69.4%	99.9%	18.2%
54	Sudan	59.2%	54.27	22.5%	75.0%	92.0%	27.2%	23.1%	6.7%
55	Ukraine	81.7%	351.60	55.4%	71.0%	76.0%	64.3%	99.9%	26.5%
56	Vietnam	98.7%	124.23	42.6%	91.0%	97.0%	79.9%	92.9%	33.3%
UPPER-MIDDLE INCOME COUNTRIES									
57	Albania	89.1%	249.58	49.3%	92.0%	99.0%	21.4%	99.3%	52.1%
58	Algeria	88.0%	573.91	73.5%	90.0%	95.0%	72.8%	96.9%	18.4%
59	Argentina	88.2%	1073.65	69.3%	56.0%	91.0%	78.2%	97.1%	62.8%
60	Azerbaijan	73.8%	198.14	22.6%	83.0%	89.0%	28.3%	99.4%	13.6%
61	Belarus	89.3%	669.17	77.2%	85.0%	98.0%	73.6%	100.0%	20.6%
62	Bosnia and Herzegov.	81.3%	665.62	71.2%	84.0%	92.0%	22.4%	99.9%	44.2%
63	Brazil	87.9%	659.13	47.5%	72.0%	97.0%	86.7%	98.1%	45.9%
64	Bulgaria	83.7%	659.19	56.3%	87.0%	95.0%	57.0%	99.5%	31.3%
65	China	99.3%	323.34	56.0%	95.0%	99.0%	94.5%	99.8%	28.7%
66	Colombia	88.6%	612.37	75.8%	72.0%	91.0%	82.6%	99.3%	29.4%
67	Costa Rica	96.5%	1008.18	74.7%	86.0%	91.0%	89.0%	99.1%	56.5%
68	Cuba	100%	1642.50	94.2%	85.0%	96.0%	87.7%	99.9%	62.0%

	Countries	DEA Score	Public spending on health per capita in Int.\$ (PPP) ²⁶	Financial protection (proxy) ²⁷	TB coverage ²⁸	DPT3 coverage ²⁹	Fam. planning coverage ³⁰	SBA coverage ³¹	ART coverage ³²
69	Dominican Republic	94.5%	309.05	50.9%	82.0%	85.0%	84.3%	98.6%	47.0%
70	Ecuador	87.8%	300.76	44.8%	75.0%	99.0%	73.9%	90.5%	31.5%
71	Iran, Islam Rep.	79.1%	491.66	40.4%	87.0%	99.0%	70.3%	96.4%	6.4%
72	Kazakhstan	85.0%	543.80	55.8%	86.0%	99.0%	72.6%	100.0%	17.4%
73	Macedonia, FYR	78.3%	520.48	65.3%	86.0%	95.0%	22.1%	98.3%	29.9%
74	Malaysia	80.1%	493.93	55.2%	78.0%	97.0%	55.6%	98.6%	20.1%
75	Mexico	90.4%	550.17	51.8%	80.0%	99.0%	80.5%	96.0%	51.1%
76	Panama	85.4%	891.65	68.6%	80.0%	85.0%	69.1%	88.5%	46.6%
77	Peru	85.3%	373.18	58.7%	67.0%	95.0%	63.0%	86.7%	43.0%
78	Romania	92.7%	788.39	80.3%	85.0%	89.0%	66.4%	98.5%	54.4%
79	Serbia	80.7%	759.53	61.2%	84.0%	91.0%	37.5%	99.7%	38.6%
80	Thailand	100%	500.29	79.5%	81.0%	99.0%	90.7%	99.5%	56.5%
81	Tunisia	86.5%	441.33	59.0%	89.0%	97.0%	69.9%	98.6%	15.9%
82	Turkey	88.5%	745.38	76.8%	88.0%	97.0%	58.0%	95.0%	36.5%
83	Venezuela	87.5%	281.87	32.4%	82.0%	81.0%	77.0%	95.7%	42.3%

Annex 6: Limitations of the analysis

There are a number of limitations to this analysis. As noted in section 2c) of the main text, our measure of financial protection does not capture the effects of a household's private spending on health on its overall economic situation and is hence a very limited measure of financial protection. As data on the preferred and more precise indicators of catastrophic and impoverishing health expenditures become more widely available, they can be used to rework this analysis.

Second, due to a lack of verified and published data for individual countries on a number of service coverage indicators, we use only a limited set of basic interventions in this paper. There is clearly no 1:1 relationship between inputs and outputs i.e. we use total public spending on health per capita, which covers a much broader set of interventions (outputs) than those captured in our analysis. We are hence likely to be underestimating the full effect of public health spending. Section 2e) provides further discussion. The analysis can be reworked when a broader set of service indicators are more widely available.

Thirdly, there may be non-public spending which influences performance on the outputs, which would mean we overestimate the effects of public spending. Given the nature of our outputs, however, we expect non-public spending to be limited.

Finally, DEA is ideally used to compare decision-making units (DMU) such as a factory, or a hospital, which operate under very similar conditions. In our analysis, the DMU is a country, and whilst we remove high-income countries from the sample there is clearly significant difference on a wide range of contextual and other factors across the 83 countries. For this reason, we focus more on variation across countries than on the frontier countries themselves.

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