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Efficiency of Health Systems in Middle-Income Countries and Determinants of Efficiency in Latin American and the Caribbean

Laura Goyeneche
Sebastian Bauhoff

Inter-American Development Bank
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Efficiency of health systems in middle-income countries and determinants of efficiency in LAC

Laura Goyeneche and Sebastian Bauhoff

We estimate the efficiency of health spending in 145 middle and high-income and the potential gains from improving efficiency for a range of health system outputs using Data Envelopment Analysis for 2010-2014 and 2015-2019 and examine associations with health system characteristics. Focusing on Latin American and Caribbean countries, we find large variability in efficiency and overall substantial potential gains in the later period, despite improvements over time. Our results suggest that, for example, improving spending efficiency could increase life expectancy at birth by 3.5 years (4.6%), or slightly more than the 3.4 year improvement in average life expectancy in the region between 2000 and 2015. Similarly, improved efficiency could reduce neonatal mortality by 6.7 per 1,000 live births (62%), increase service coverage by 6 percentage points (8.7%), and reduce the rich-poor gap in birth attendance by 10 percentage points (12.6%). We find that governance quality is positively associated with efficiency. Overall, the findings indicate an urgent need to improve efficiency in the region and substantial scope for realizing the potential gains of such improvements.

JEL codes: H51; I10; I18

Keywords: health system efficiency; health care spending; Data Envelopment Analysis, Latin America and the Caribbean

Abstract

English

We estimate the efficiency of health spending in 145 middle and high-income and the potential gains from improving efficiency for a range of health system outputs using Data Envelopment Analysis for 2010-2014 and 2015-2019 and examine associations with health system characteristics. Focusing on Latin American and Caribbean countries, we find large variability in efficiency and overall substantial potential gains in the later period, despite improvements over time. Our results suggest that, for example, improving spending efficiency could increase life expectancy at birth by 3.5 years (4.6%), or slightly more than the 3.4 year improvement in average life expectancy in the region between 2000 and 2015. Similarly, improved efficiency could reduce neonatal mortality by 6.7 per 1,000 live births (62%), increase service coverage by 6 percentage points (8.7%), and reduce the rich-poor gap in birth attendance by 10 percentage points (12.6%). We find that governance quality is positively associated with efficiency. Overall, the findings indicate an urgent need to improve efficiency in the region and substantial scope for realizing the potential gains of such improvements.

Spanish

Este artículo estima la eficiencia del gasto en salud en 145 países de ingresos medios y altos, así como los posibles beneficios de mejorar la eficiencia en múltiples áreas del sistemas de salud. Utilizamos el Análisis Envolvente de Datos (Data Envelopment Analysis, DEA) para los años 2010-2014 y 2015-2019 para calcular eficiencia, y examinamos sus asociaciones con las características del sistema de salud. Centrándonos en los países de América Latina y el Caribe, encontramos una gran variabilidad en la eficiencia y en los beneficios esperados en 2014-2019. Nuestros resultados sugieren que, por ejemplo, mejorar la eficiencia del gasto podría aumentar la esperanza de vida al nacer en 3.5 años (4.6%), reducr la mortalidad neonatal en 6.7 por cada 1,000 nacidos vivos (62%), aumental la cobertura de servicios en 6 puntos porcentuales (8.7%) y reducir la brecha entre ricos y pobres en la atención especializada en el parto en 10 puntos porcentuales (12.6%). Encontramos también que la calidad de la gobernanza está positivamente relacionada con la eficiencia. En general, los hallazgos indican la importancia de mejorar la eficiencia en la región y reflejan un gran potencial para obtener beneficios singificantivos mediante estas mejoras.

Portuguese

Estimamos a eficiência dos gastos com saúde em 145 países de renda média e alta e os ganhos potenciais da melhoria da eficiência para uma série de resultados do sistema de saúde usando a Análise Envoltória de Dados (Data Envelopment Analysis, DEA) para 2010-2014 e 2015-2019, e examinamos associações com características do sistema de saúde. Centrando-nos nos países da América Latina e do Caribe, encontramos uma grande variabilidade na eficiência e ganhos potenciais globais substanciais no período posterior, apesar das melhorias ao longo do tempo. Nossos resultados sugerem que, por exemplo, melhorar a eficiência dos gastos poderia aumentar a expectativa de vida ao nascer em 3,5 anos (4,6%), reduzir a mortalidade neonatal em 6,7 por 1.000 nascidos vivos (62%), aumentar a cobertura do serviço em 6 pontos percentuais (8,7%) e reduzir a disparidade entre ricos e pobres na assistência ao parto em 10 pontos percentuais (12,6%). Descobrimos que a qualidade da governação está positivamente associada à eficiência. No geral, as conclusões indicam uma necessidade urgente de melhorar a eficiência na região e uma margem substancial para concretizar os ganhos potenciais de tais melhorias.

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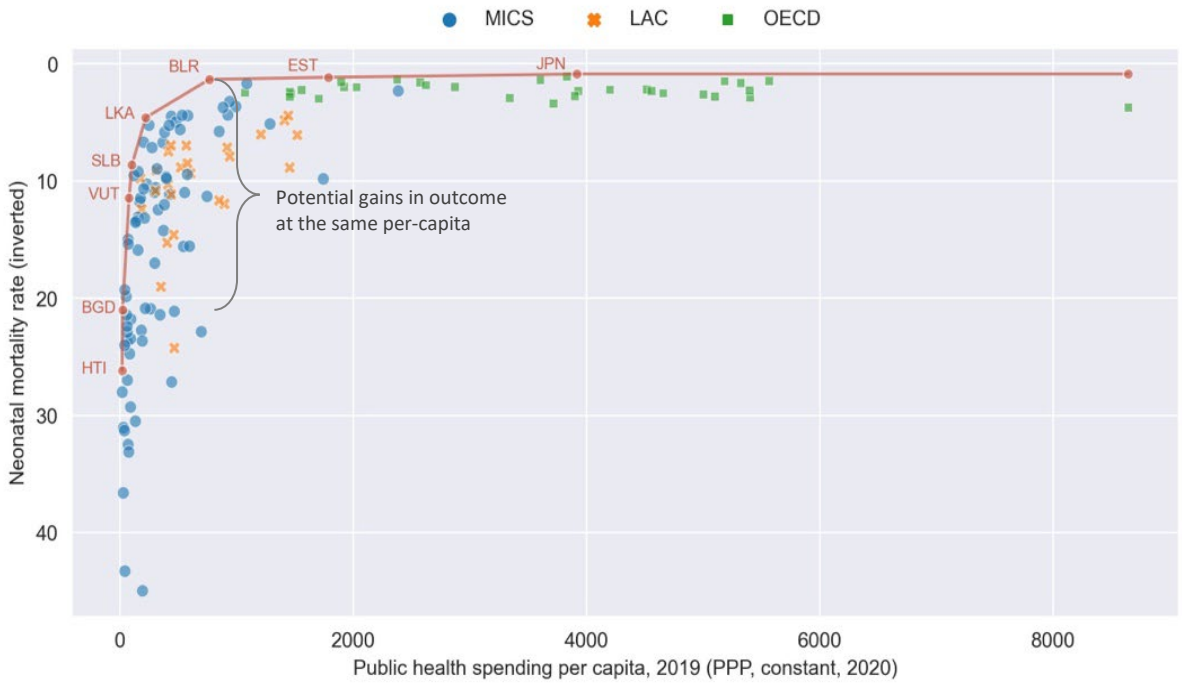
1. Introduction

Increasing the efficiency of health spending is a renewed priority for many middle-income countries that have invested in universal health coverage (UHC) and are concerned about the financial sustainability of their commitments. On average, Latin American and the Caribbean (LAC) countries have improved on the United Nation's UHC index from 49.8 in 2000 to 70.9 in 2019 as well as on key health outcomes, such as neonatal mortality and life expectancy. In the same period, per capita health expenditures have increased from US$287 to US$648. Although spending on health in LAC remains low relative to OECD countries (8.4 percent of GDP relative to 13.9 percent in 2020, respectively), it is projected to increase rapidly (Rao et al. 2022). This projected increase will occur in the context of likely post-pandemic contraction of public health spending and challenging macroeconomic conditions (Kurowski et al. 2021). As a result, improving spending efficiency is even more important in the coming years.

The substantial variation in healthcare outcomes among countries with comparable health expenditures suggests an untapped potential for nations to enhance coverage, outcomes, and equity by improving their spending efficiency. Figure 1 shows that many countries in LAC could achieve better outcomes with similar per-capita spending if they were as efficient as their peers. For example, Ecuador and Mexico have similar public health spending per capita (approximately US$571 and $581 in 2019) yet their neonatal mortality rates were notably different at 7.0 and 8.51 per 1,000 live births, respectively. Similarly, El Salvador and the Dominican Republic have similar levels of per-capita spending ($439 and $467, respectively) but at 7.0 per 1,000 live births, El Salvador's neonatal mortality rate is more than three times lower than that of the Dominican Republic (24.3 per 1,000 live births).

Figure 1. Neonatal mortality and health expenditure per capita efficiency frontier (illustrative)



Source: Author's calculations.
Notes: The frontier is drawn for illustration, not derived analytically.

In this paper, we use robust data envelopment analysis (DEA) to estimate the efficiency of health spending and the potential gains from improving efficiency in 145 countries – including 26 LAC – in 2010-2014 and 2015-2019 and examine associations of efficiency with health systems characteristics. DEA is a non-parametric empirical method that identifies the efficiency frontier consisting of peer countries with the highest performance at each level of spending, accounting for contextual factors. This allows for estimating each country's efficiency as distance to the frontier and the potential gains that countries could achieve by moving to the frontier (Cylus, Papanicolas, and Smith 2016; Jacobs, Smith, and Street 2006). We apply output-oriented robust DEA to health outcomes such as infant mortality, life expectancy at birth and disability-adjusted life years lost (DALYs), as well as the overall UHC index and its components. We also consider equity gaps between the richest and poorest quintiles and urban and rural populations in skilled birth attendance.

We report three main sets of results. First, there are large potential gains from improving efficiency in LAC, but there is large variability across countries. Averaging across countries, the LAC region could gain about 3.5 years of life expectancy at birth (4.6 percent of the average of 75 years), reduce neonatal mortality by 6.7 deaths per 1,000 live births (relative to an average of 10.7 deaths), increase overall UHC service coverage by 6 percentage points and coverage of NCD services by about 13 percentage points. It could further increase the share of births attended by skilled health staff by 4.4 percentage points and narrow the poor/rich gap in skilled birth attendance by 10 percentage points. Second, efficiency improved slightly in the 2010s, as most outputs had higher efficiency scores in the later period. Third, we find that efficiency is positively associated with governance quality.

Our analysis makes three main contributions to previous research on countries' efficiency of health spending. First, we provide updated country-specific estimates of health spending efficiency and potential gains for a larger set of outcomes than in previous studies, including the UHC index. Focusing on LAC countries in the period 2011-2015, Moreno-Serra et al. (2019) used DEA to examine several health outcomes and coverage measures for individual LAC countries for the combined period 2011-2015. Their results show large and variable potential gains. For example, their estimates suggest that LAC could gain around five years (7) in life expectancy at birth from improving efficiency but these potential gains range from 1.7 in Costa Rica to 10.4 in Trinidad and Tobago. Garcia-Escribano et al. (2022) found similar average potential gains in life expectancy at birth for LAC in 2017 but did not report country-level estimates. Second, we report on country-specific changes in potential gains between the early and late 2010s. Garcia-Escribano et al. (2022) finds improved efficiency in most countries between 2003-2007 and 2013-2017 but does not identify countries. Third, we examine both correlates of efficiency in 2016-2019 and improvements in efficiency over time. The earlier studies focused on correlates of cross-sectional efficiency and found indicative associations with governance quality in LAC (Moreno-Serra, Anaya-Montes, and Smith 2019) and inequality and control of corruption for the group of emerging markets and developing economies (Garcia-Escribano, Mogues, and Juarros 2022).

Our results are directly relevant to policy deliberations on increasing the returns to spending on health and expanding the resources available for the health sector (Barroy et al. 2021). Our analysis suggests that the potential gains from improving efficiency are sizeable: many countries could substantially improve outcomes if they spent their resources with similar efficiency as their peers. Moreover, our findings indicate that certain institutional features – in particular, governance quality – could help countries improve efficiency and realize these potential gains.

2. Methods and data

2.1. Data Envelopment Analysis (DEA)

2.1.1. Methodology

We use output-oriented, bias-corrected data envelopment analysis (DEA) to evaluate the efficiency of the health system in LAC. DEA is a non-parametric method that estimates the relative efficiency of decision-making units (DMUs) by creating a piecewise-linear frontier on the highest-performing units and evaluating the performance of all units relative to this frontier (Cook and Seiford 2009; Garcia-Escribano, Mogues, and Juarros 2022). DEA evaluates efficiency relative to actual peer performance, and output-oriented efficiency estimates the required changes in the output value to reach the frontier at the same input level while input-oriented efficiency assesses the changes in the input value required to achieve the same output level in the frontier. Garcia-Escribano et al. (2022) finds that estimated efficiency scores from output and input-oriented DEAs are highly correlated. We estimate single-output DEAs because multi-output DEAs can reduce the ability to discriminate among countries and may assign unreasonable weights to some outputs (Moreno-Serra, Anaya-Montes, and Smith 2019). We conducted the analysis using the DEA implementation of Ji and Lee (2010) in Stata MP 17 (StataCorp 2022).

The efficiency estimates produced by DEA show "feasible" improvements and can under-state the full scope for improvement. That is because DEA evaluates efficiency relative to the empirical frontier consisting of peer countries' observed performance rather than a benchmark of full efficiency. In this sense, countries with high DEA efficiency scores may still be able to improve outcomes with the same spending. Moreover, countries may lie on the efficiency frontier by construction if they do not have peers with comparable spending levels. This can occur in cases where countries have unusually high or low per-capita spending, such as the U.S.A. and Haiti, respectively.

For our analysis and following Moreno-Serra et al. (2019), our analysis sample includes LAC countries as well as OECD and non-LAC middle-income countries (MICs) that have similar per-capita health spending. We consider 18 outputs related to population health status or health outcomes, service coverage, access to services, and equity. These outputs differ in the extent to which they are amenable to health care or the health system. For example, life expectancy at birth depends on many factors outside of the health system, while neonatal mortality and service coverage may be more directly influenced by health systems and policies.

1. Health outcomes: life expectancy at birth (years), healthy life expectancy at birth (years), the neonatal mortality rate per 1,000 live births, under-5 mortality rate per 1,000 live births, disability-adjusted life years lost (DALYs) for all causes per 100,000 population, DALYs for non-communicable diseases (NCD) per 100,000 population, DALYs for maternal causes per 100,000 population, and DALYs for neonatal causes per 100,000 population.
2. Service coverage:[1] universal health coverage (UHC) service coverage index, including its components: service capacity on access, NCD, reproductive, maternal, newborn, and child health (RMNC), and infectious diseases.

[1] In line with the Sustainable Development Goals, we consider universal health coverage as a policy goal and therefore an output of the health system. In contrast, Garcia-Escribano et al. (2022) include the UHC index in their analysis of potential determinant of efficiency.

3. Access to services: percentage of skilled birth attendance, and DPT immunization rate (% of children aged 12 to 23 months).
4. Equity: ratio of the poorest/richest wealth quintiles of births attended by skilled health staff, as well as the ratio of rural/urban births attended by skilled health staff.

The main input is public health spending per capita (PPP, constant, 2020) and other inputs (external constraints) are GDP per capita (PPP, constant, 2020) and population aged 65 and above. As Moreno-Serra et al. (2019) note, other possibly relevant inputs – including social and environmental determinants – tend to be highly correlated with our input set. In sensitivity analyses, we estimate models using total, public, and pooled health spending per capita only, and total and pooled health spending instead of public health spending per capita with the external constraints (GDP per capita and population aged 65 and above). We obtained similar results from a model with only health spending, suggesting that adding more inputs may not qualitatively affect the findings (see Appendix Figure C1 and Figure C2). These sensitivity tests did not produce substantively different results from our main model (see Appendix C).

We present the results potential gains and their percentage increase compared to the baseline and report the estimated efficiency scores in the Appendix. The corresponding potential gains from moving to the frontier are expressed in the units of the output.

2.1.2. Data

We use data between 2010-2014 and 2015-2019 for a total of 145 countries, consisting of 26 LAC countries, 34 non-LAC OECD countries, and 89 non-LAC middle-income countries (MICs). The data come from the World Bank World Development Indicators (WDI), World Bank Worldwide Governance Indicators, World Health Organization (WHO) Global Health Observatory, WHO Global Health Expenditure Database, and the Institute of Health Metrics and Evaluation (IHME). Appendix A lists the countries and sources for all variables.

We transform the data in two ways. First, to ensure consistency in our analysis, we adopted a “more is better” approach by using the inverse of the percentage of the population aged 65 or more, mortality rates, and burden of disease rates (see Appendix Table A1). Second, we use average values to account for outliers resulting from external shocks, data measurement errors, and missing values in specific years. The data for health outcomes, access to services, and the explanatory variables are averages between 2010-2014 and 2015-2019, respectively; the service coverage is a 2017-2019 and 2010-2015 and the equity measures use the most recent data available.

2.2. Association with health systems characteristics in LAC

To estimate the associations between efficiency scores for each output indicator and various potential efficiency determinants, we employed the Simar-Wilson cross-sectional regressions. This approach takes into account the bounded nature of DEA efficiency scores, corrects the standard errors obtained from conventional regression models, and simulates the unknown correlation among efficiency scores while calculating bootstrapped standard errors (Garcia-Escribano, Mogues and Juarros 2022; Moreno-Serra, Anaya-Montes, and Smith 2019; Simar and Wilson 2007).

We examine two broad categories of potential determinants of efficiency that are related to the health system. First, as measures of the organization of healthcare financing and delivery, we utilized the out-of-pocket health expenditure as a proportion of the total health expenditure and the number of hospital beds per 1,000 people. Second, as a measure of the quality of governance, we computed an average score

based on six governance dimensions derived from the World Bank Worldwide Governance Indicators. These dimensions include government effectiveness, voice and accountability, rule of law, regulatory quality, political stability and absence of violence/terrorism, and control of corruption. We focus on determinants that could be influenced by health policy but note that other studies have found efficiency to be associated with broader characteristics of countries, e.g., income levels, income inequality, and education (Garcia-Escribano, Mogues, and Juarros 2022; Greene 2004).

3. Results

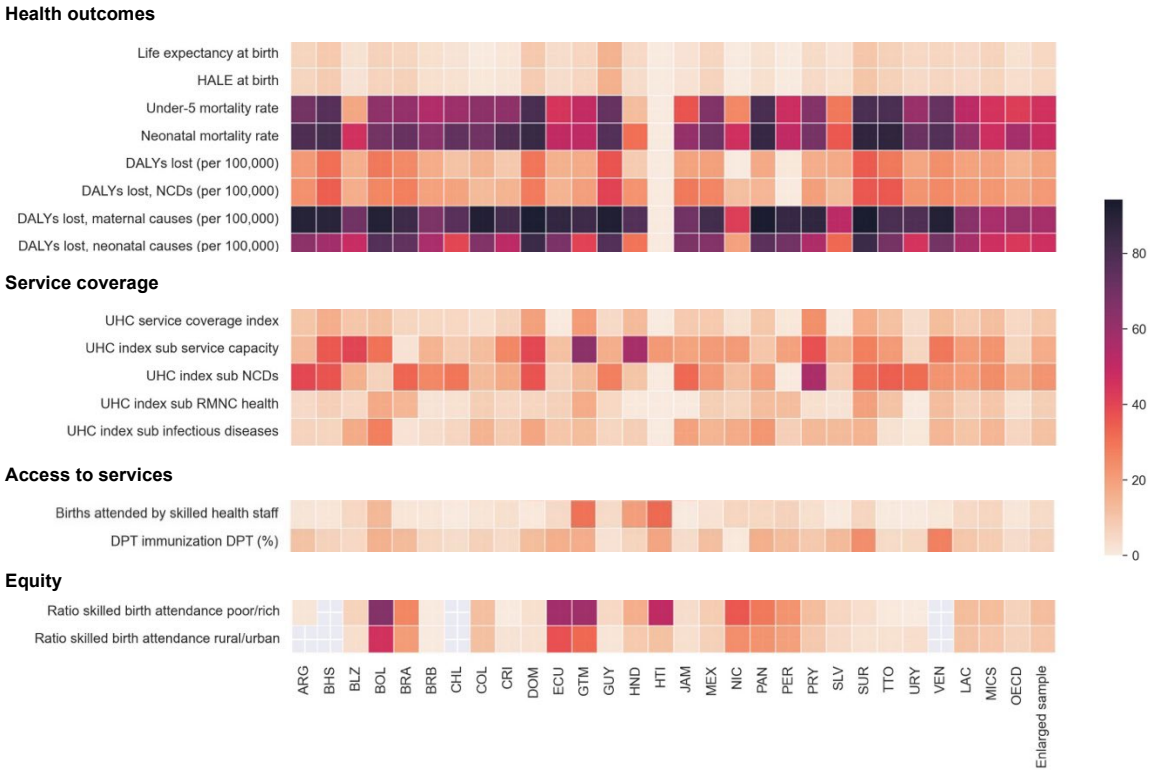
3.1. Health system potential gains

Overall, our analysis revealed significant potential for LAC countries to generate more output for the same per-capita health spending. Table 1 and Figure 2 shows the average potential gains and the variation relative to the baseline that can be achieved across indicators of system performance in different regions (for numeric estimates and confidence intervals see Appendix Table C3). These potential gains represent the average improvements in outputs that regions could attain by moving to the estimated efficiency frontier. They reflect the empirical pattern of the efficiency scores.

Relative to baseline values, the region could improve life expectancy at birth by 4.6 percent (3.45 years), reduce neonatal mortality by 62 percent (6.7 per 1,000 live births), increase service coverage by 8.7 percent (6 percentage points), and reduce the rich-poor gap in birth attendance by 12.6 percent (10 percentage points). The relative potential gains for DALYs lost to maternal and neonatal causes are higher than the gains for DALYs lost due to NCDs. The reverse holds for coverage, where the potential gains for NCDs are relatively larger than for reproductive, maternal, newborn, and child health services. As a region and as a percent of baseline output, LAC generally has lower potential gains than non-LAC MICs and higher potential gains than OECD countries, reflecting that the latter have higher efficiency (Figure 2 and Appendix Table C4). For example, the OECD and non-LAC MICs could improve life expectancy at birth by 2.8 percent and 6.5 percent respectively. LAC has similar or more potential gains as other MICs with regards to DAYLs lost and equity-in-access.

There is substantial heterogeneity in the efficiency of health spending within LAC, across countries and outputs. On average, fewer than 30 percent of LAC countries have lower potential gains (relative to baseline) than observed in OECD countries and 47 percent outperformed the average potential gains of non-LAC MICs. El Salvador, Barbados, Chile, and Costa Rica have lower relative potential gains than the LAC average for at least 13 of the 17 indicators assessed. For life expectancy and HALE at birth, Haiti, Peru, and Nicaragua showed the lowest potential gains. El Salvador, Haiti, Ecuador, Peru, Nicaragua, and Colombia had the smallest potential to improve the overall coverage index, relative to their baselines. Meanwhile, Costa Rica and Barbados had the smallest relative potential gains to improve on the equity measures.

Figure 2. Cross-country variation in potential gains (percent relative to baseline), 2015-2019



Source: Author's calculations.

Notes: Average efficiency scores for MICS and OECD countries include countries in LAC. "Enlarged sample" includes LAC, non-LAC MICS, and non-LAC OECD countries. Results from output-oriented DEA model using as input variables public health spending per capita, GDP per capita, and population aged 65 and above.

Table 1 shows country-level potential gains for selected outputs. Overall, Bolivia, Dominican Republic, Guatemala, Guyana, and Suriname have the largest potential gains for seven or more of the 17 indicators assessed, exhibiting substantial opportunities for improvement. Among health outcomes, in the Dominican Republic, Guyana, and Suriname, life expectancy at birth could increase by between 6.7 to 10.2 years (an increase between 10 to 15 percent). In these countries, neonatal mortality could be reduced by between 10.5 to 20.7 deaths per 1,000 live births, a reduction between 78 to 88 percent. For service coverage, the UHC index shows a potential increase of up to 11.7 to 14.4 percentage points in the Dominican Republic, Guatemala, and Paraguay, with a greater potential for the service capacity and NCDs sub-index of up to 20 percentage points (Appendix Table C4). For access to services outputs, the largest potential gains are observed in Guatemala and Venezuela, with a potential increase of 21.1 percentage points in the skilled birth attendance rate and a potential increase of 19.5 percentage points in DPT immunization, respectively. The ratios in skilled birth attendance could also be reduced by 20 percentage points for the poor/rich and rural/urban gap in Bolivia, Ecuador, and Guatemala. Haiti has the lowest potential gains (highest efficiency scores) for its per-capita spending, including zero potential gains or most outputs, indicating that it lies on the efficiency frontier.

Table 1. Potential gains due to more efficient health spending by country in LAC (2015-2019)

Country	Public health spending per capita	Life expectancy at birth	Neonatal mortality rate	DALYs lost (per 100,000)	UHC service coverage index	Births attended by skilled health staff	Ratio of skilled births attendance poor/rich
ARG	$1,523	4.72	4.82	5,967	7.69	1.67	0.02
BHS	$921	6.61	5.81	9,620	11.16	1.23	--
BLZ	$313	1.92	4.23	4,110	6.64	4.62	0.06
BOL	$406	4.94	10.59	9,048	7.41	11.63	0.23
BRA	$607	4.44	6.78	7,695	4.40	1.30	0.19
BRB	$524	2.50	5.67	5,365	4.04	1.13	0.00
CHL	$1,413	1.53	3.58	2,644	4.22	0.24	--
COL	$943	0.29	5.54	3,673	2.70	1.69	0.11
CRI	$1,210	1.09	4.73	2,129	5.09	2.91	0.00
DOM	$468	6.72	20.68	9,213	12.66	0.38	0.03
ECU	$571	3.06	3.52	3,967	0.00	4.40	0.25
GTM	$188	4.02	6.32	5,022	11.72	21.12	0.24
GUY	$353	10.19	14.77	14,832	3.40	4.07	0.05
HND	$178	3.39	3.04	2,351	7.98	16.03	0.14
HTI*	$20	0.00	0.00	0	0.00	13.40	0.09
JAM	$414	1.85	6.27	5,081	6.33	0.30	0.04
MEX	$581	4.34	6.01	5,294	6.47	2.50	0.08
NIC	$306	0.09	5.10	0	1.92	5.41	0.23
PAN	$1,457	2.20	7.59	4,055	7.43	5.11	0.21
PER	$417	0.00	3.80	233	0.77	6.39	0.17
PRY	$442	3.33	7.63	4,010	14.36	3.19	0.11
SLV	$439	1.73	2.50	5,115	0.00	0.04	0.05
SUR	$898	7.26	10.50	11,820	11.34	5.46	0.04
TTO	$853	5.45	10.24	9,419	8.08	0.00	0.00
URY	$1,445	3.71	3.17	5,689	2.98	0.02	0.00
VEN	$464	4.21	11.31	6,806	8.85	0.89	--
LAC	$667	3.45	6.70	5,506	6.06	4.43	0.10
MICS	$395	4.58	6.93	6,854	7.36	4.99	0.10
OECD	$3,201	2.25	1.59	4,288	3.91	1.20	0.06
Total	$1,161	4.00	5.56	6,238	6.50	3.97	0.09

Source: Author's calculations.

Notes: Table 1 presents a subset of output indicators, for the complete table of efficiency scores for all output indicators considered, see Table B2 in the Appendix. Results from output-oriented DEA model using as input variables public health spending per capita, GDP per capita, and population aged 65 and above. Public health spending per capita (PPP, constant, 2020) corresponds to the 2015-2019 average value. * Haiti's spending is uniquely low and therefore on the efficiency frontier by construction, for many outputs.

3.2. Evolution of health efficiency over time

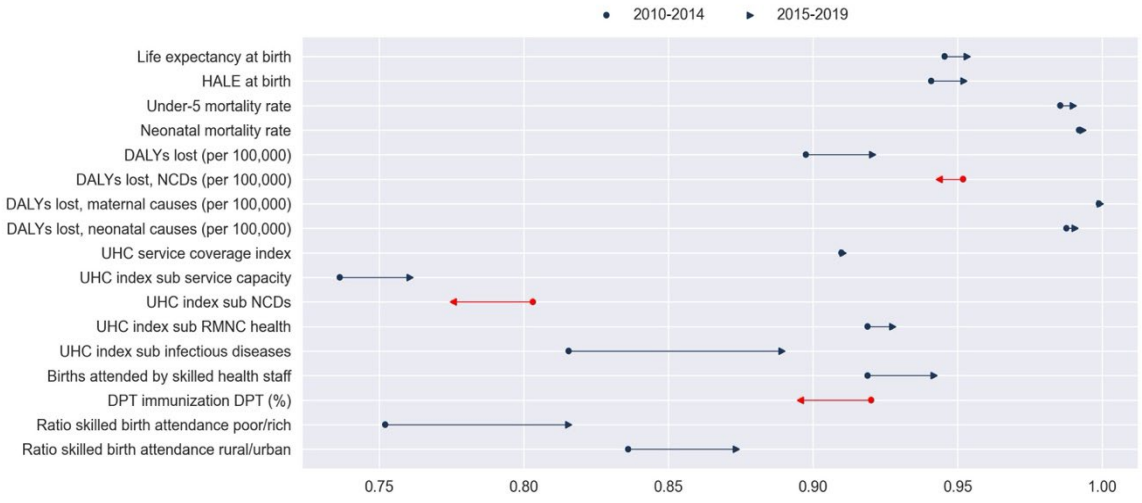
LAC experienced improvements in efficiency for most outputs between 2010 to 2014 and 2015 to 2019. 14 of the 17 outputs had higher efficiency scores in the later period (Figure 3, for numeric estimates, see Appendix Table C2). The largest improvements are for the UHC sub-index for infectious diseases, as well as the ratio for skilled birth attendance for the poor/rich and rural/urban, with increases of 7.5, 6.3, and 3.7 percentage points, respectively. No significant changes were observed in DALYs lost for maternal causes and the UHC index. The UHC sub-index for NCDs and the DPT immunization rate, on the other side, showed a decrease of 2.8 and 2.4 percentage points, respectively.

Colombia, Ecuador, Honduras, and Haiti demonstrated improvements in efficiency in between 13 to 16 outputs. Colombia showed large improvements in the UHC sub-index for infectious diseases (26 percentage points) and service capacity (5.3 percentage points) but experienced a decline of

2 percentage points in the UHC sub-index for NCDs. Ecuador exhibited the largest increase in the UHC sub-index for infectious diseases (19 percentage points) and skilled birth attendance (4.3 percentage points). Honduras demonstrated progress in the ratios of skilled birth attendance for the poor/rich (33.2 percentage points) and rural/urban (13.8 percentage points), but experienced a decline in the UHC sub-index for NCDs, skilled birth attendance, and DPT immunization, by 2.2, 3.3, and 5.8 percentage points, respectively. As noted above, Haiti defines the frontier because it is unique at its level of spending, so that results need to be interpreted cautiously. With this caveat, Haiti saw an increase in most indicators except for the UHC sub-index for NCDs, which remained unchanged.

In contrast, Uruguay, Bahamas, Suriname, Dominican Republic, and Mexico showed improvements in fewer than 7 outputs, with declines in the UHC index, the UHC sub-index for NCDs, and DPT immunization. Venezuela experienced a decrease in spending efficiency in all 17 outputs.

Figure 3. Change in efficiency score in LAC countries, 2010-2014 vs. 2015-2019



Source: Author's calculations.
Notes: Average efficiency scores for the 26 countries in LAC.

3.3. Potential determinants of health efficiency

We employed a Simar-Wilson regression to estimate the level of correlation between the estimated DEA efficiency scores for all outputs and a set of potential efficiency determinants (Table 2). We observed significant associations between the health system organization and governance quality indicators and efficiency scores (Table 2; for further details see Appendix Table D1). Focusing on the enlarged sample, we found that governance quality is positively associated with most outputs, particularly health and service coverage outcomes. Our estimations indicate that a one-unit increase in the average governance quality leads to an improvement of 0.035 and 0.061 in the efficiency scores for DALYs lost per 100,000 people and the UHC coverage index, respectively. This translates to a reduction of 4,270 DALYs and an increase of 7.4 percentage points in the coverage index if LAC achieved the OECD-average governance quality for the same level of public health spending. Furthermore, the number of hospital beds per 1,000 people is negatively associated with efficiency for health outcomes, but positively associated with coverage indices, access (skilled birth attendance), and the ratio in skilled birth attendance for the poor/rich and urban/rural areas.

Table 2. Potential determinants of efficiency, 2015-2019

	Life expectancy at birth	DALYs lost per 100,000 people	UHC services coverage index	Births attended by skilled health staff	Ratio skilled birth attendance poor/rich
	(1)	(2)	(3)	(5)	(6)
OOP health expenditure as % of CHE	0.000	0.000	-0.001	-0.010	0.032
	0.000	(0.001)	(0.001)	(0.006)	(0.020)
Hospital beds per 1.000 people	-0.005*	-0.010**	-0.005	0.334*	1.889**
	(0.003)	(0.004)	(0.006)	(0.179)	(0.757)
Average governance quality	0.023***	0.035**	0.061***	0.089	0.978
	(0.008)	(0.014)	(0.019)	(0.116)	(0.770)
Constant	0.979***	0.954***	0.970***	1.341***	-1.201
	(0.019)	(0.031)	(0.043)	(0.348)	(1.063)
Observations	77	79	75	66	36
Model chi-squared	13.825	10.395	16.398	4.220	6.230
Model significance, p-value	0.003	0.015	0.001	0.239	0.101

Source: Author's calculations.
Notes: Simar-Wilson models estimated with 1,000 bootstrap replications. Robust standard errors in parenthesis. *p<0.1, **p<0.5, **p<0.01. Results using enlarged sample, which includes LAC, non-LAC MICS, and non-LAC OECD countries. Additional results are available in Appendix Table D1.

In addition to the results with the enlarged sample, we further explored a model that included only the 26 countries in the LAC region. We found no significant associations between these indicators and efficiency scores for health and equity outcomes (Appendix Table D1). For service coverage, we found that higher shares of OOP expenditures (for infectious diseases) and higher governance quality (for RMNCH) are associated with higher efficiency in the service coverage sub-indices for RMNCH and infectious diseases. Similarly, there is preliminary indication that better governance is associated with higher efficiency in providing access to necessary services such as DTP immunization.

4. Discussion

We find that across LAC countries, improving health spending efficiency could produce large gains in health outcomes, service coverage, and equity. For example, by moving vertically to the empirical efficiency frontier, the average country in LAC could gain about 3.5 more life years at birth (4.6 percent), increase overall UHC service coverage by 6 percentage points (8.7 percent), and reduce poor/rich gap in skilled birth attendance by 10 percentage points (12.6 percent). Efficiency is low with regard to service coverage for NCDs and equity in the delivery of basic services, such as skilled birth attendance. As a group, LAC countries relative to other regions, have middling spending efficiency: lower than the OECD and higher than non-LAC MICs. Spending efficiency appears to have improved slightly since the 2010s in LAC, and higher efficiency is associated with governance quality.

Together with earlier research, our results highlight the urgent need for LAC and MICs to improve spending efficiency. For context, average life expectancy at birth in LAC improved by 3.4 years between 2000 and 2015, that is, the potential gains of 3.5 years from improving spending efficiency are comparable to 15 years of progress. While all regions could improve efficiency, the scope in LAC and MICs is larger than in higher-income settings. For example, our analysis suggests that, as a group, OECD countries could gain 2.8 percent of life expectancy at birth compared to 4.6 percent in LAC and 6.5 percent in MICs. Moreover, while efficiency appears to have improved over time, there is substantial scope for further improvement especially with regard to outputs that are core challenges for the region, including NCDs and access to services. These topics deserve broader attention, e.g., also with regard to universal health coverage (Lozano et al. 2020).

Our analysis does not support reducing or maintaining spending on health in LAC countries. OECD countries spend more and have better outcomes, which suggests that increasing spending in LAC could lead to improvements in outcomes. The policy challenge, therefore, lies in ensuring that current and future spending are as efficient as possible.

Countries can deploy a range of specific policies to improve efficiency (OECD 2017; Savedoff et al. 2023; Yip and Hafez 2015). This includes prioritizing cost-effective interventions in designing benefit plans, investing in prevention and primary care, disinvesting in technologies and health care services with no or low value, reducing clinical, operational, and admin waste (OECD 2017), promoting generic drugs, improving procurement processes, shifting toward output-based payment systems, strengthening managerial capacity, reducing fragmentation, using digital tools where appropriate, tackling corruption and improving accountability. In addition, countries should improve public financial management in the health sector, which can help translate efficiency gains into fiscal space for health (Barroy et al. 2021).

Our analysis shares the limitations noted in earlier work (Garcia-Escribano, Mogues, and Juarros 2022; Moreno-Serra, Anaya-Montes, and Smith 2019). First, the DEA efficiency frontier is constructed based on observed performance, which is likely lower than feasible performance. We may therefore over-estimate countries' efficiency. Related, for some countries there are no comparable peers, so the country attains the efficiency frontier by construction. This is the case of Haiti, which has uniquely low per-capita spending in LAC and appears to be highly efficient, which needs to be interpreted cautiously. Excluding Haiti does not affect our main conclusions for the other countries (Appendix Table C1 and C3). Second, the DEA is highly sensitive to transformations of inputs and outputs, particularly when dealing with undesirable outputs transformed using a non-linear function (Zhou et al. 2019). This is the case for outputs such as mortality, for which we used the inverse in the calculations. In such cases, the efficiency scores show minimal variations across countries and regions. This does not affect the estimated potential gains, which is our focus. Third, the simulated potential gains from policy actions are based on associations of potential determinants with outputs that may not represent causal relationships. This analysis is also limited by the availability of global data on determinants of health system performance. Fourth, we describe the macro efficiency of health spending which should be complemented with evidence on the levels and determinants of efficiency at the micro level, e.g., for hospitals and clinics or the provision of NCD care.

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7. Appendix

Appendix A. Description and data sources

Sample of countries

We used data from countries in Latin America and the Caribbean (LAC), Organisation for Economic Co-operation and Development (OECD), and middle-income countries (MICS).

For LAC, we used data from 26 countries including Argentina (ARG), Bahamas (BHS), Barbados (BRB), Belize (BLZ), Bolivia (BOL), Brazil (BRA), Chile (CHL), Colombia (COL), Costa Rica (CRI), Dominican Republic (DOM), Ecuador (ECU), El Salvador (SLV), Guatemala (GTM), Guyana (GUY), Haiti (HTI), Honduras (HND), Jamaica (JAM), Mexico (MEX), Nicaragua (NIC), Panama (PAN), Paraguay (PRY), Peru (PER), Suriname (SUR), Trinidad and Tobago (TTO), Uruguay (URY), and Venezuela (VEN).

For OECD, we used data from 34 countries including Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Switzerland (CHE), Czech Republic (CZE), Germany (DEU), Denmark (DNK), Spain (ESP), Estonia (EST), Finland (FIN), France (FRA), United Kingdom (GBR), Greece (GRC), Hungary (HUN), Ireland (IRL), Iceland (ISL), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Lithuania (LTU), Luxembourg (LUX), Latvia (LVA), Netherlands (NLD), Norway (NOR), New Zealand (NZL), Poland (POL), Portugal (PRT), Slovak Republic (SVK), Slovenia (SVN), Sweden (SWE), Turkey (TUR), and United States (USA). We also included data from 4 OECD LAC countries: Chile (CHL), Colombia (COL), Costa Rica (CRI), and Mexico (MEX).

For MICS, we used data from 49 lower-middle-income and 40 upper-middle-income. For lower MICS we included Angola (AGO), Benin (BEN), Bangladesh (BGD), Bhutan (BTN), CÃ´te d'Ivoire (CIV), Cameroon (CMR), Congo, Rep. (COG), Comoros (COM), Cabo Verde (CPV), Djibouti (DJI), Algeria (DZA), Egypt, Arab Rep. (EGY), Micronesia, Fed. Sts. (FSM), Ghana (GHA), Indonesia (IDN), India (IND), Iran, Islamic Rep. (IRN), Kenya (KEN), Kyrgyz Republic (KGZ), Cambodia (KHM), Kiribati (KIR), Lao PDR (LAO), Lebanon (LBN), Sri Lanka (LKA), Lesotho (LSO), Morocco (MAR), Myanmar (MMR), Mongolia (MNG), Mauritania (MRT), Nigeria (NGA), Nepal (NPL), Pakistan (PAK), Philippines (PHL), Papua New Guinea (PNG), West Bank and Gaza (PSE), Senegal (SEN), Solomon Islands (SLB), Sao Tome and Principe (STP), Eswatini (SWZ), Tajikistan (TJK), Timor-Leste (TLS), Tunisia (TUN), United Republic of Tanzania (TZA), Ukraine (UKR), Uzbekistan (UZB), Viet Nam (VNM), Vanuatu (VUT), Samoa (WSM), and Zimbabwe (ZWE). For upper MICS we included Albania (ALB), Armenia (ARM), American Samoa (ASM), Azerbaijan (AZE), Bulgaria (BGR), Bosnia and Herzegovina (BIH), Belarus (BLR), Botswana (BWA), China (CHN), Cuba (CUB), Dominica (DMA), Fiji (FJI), Gabon (GAB), Georgia (GEO), Equatorial Guinea (GNQ), Grenada (GRD), Iraq (IRQ), Jordan (JOR), Kazakhstan (KAZ), Libya (LBY), St. Lucia (LCA), Republic of Moldova (MDA), Maldives (MDV), Marshall Islands (MHL), North Macedonia (MKD), Montenegro (MNE), Mauritius (MUS), Malaysia (MYS), Namibia (NAM), Palau (PLW), Russian Federation (RUS), Serbia (SRB), Thailand (THA), Turkmenistan (TKM), Tonga (TON), Turkey (TUR), Tuvalu (TUV), St. Vincent and the Grenadines (VCT), Kosovo (XKX), and South Africa (ZAF). We also included 19 LAC MICS countries, that includes all countries but Bahamas (BHS), Chile (CHL), Panama (PAN), Trinidad and Tobago (TTO), Uruguay (URY), and Venezuela (VEN).

Table A1. Input and output indicators

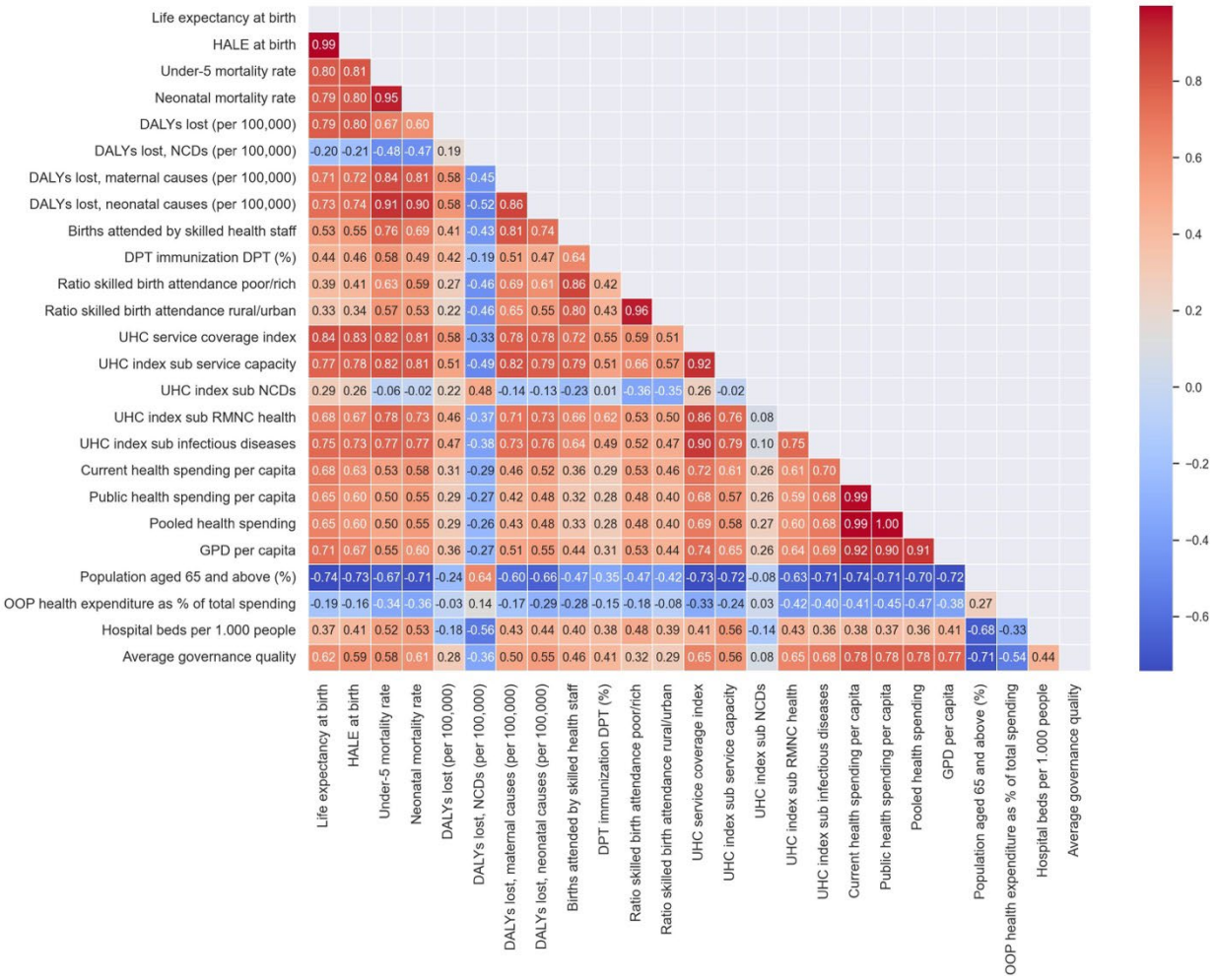
Variables	Year	Source
Input variables		
Population aged 65 and more (% of total) *	2015-19	WHO-GHED
Health expenditure per capita, PPP (constant 2020 USD $)	2015-19	WHO-GHED
GDP per capita, PPP (constant 2020 USD $)	2015-19	WHO-GHED
Output variables		
Health outcomes		
Life expectancy at birth (years)	2015-19	IHME-GBD
Healthy life expectancy at birth (years)	2015-19	IHME-GBD
Neonatal mortality rate per 1,000 live births *	2015-19	WHO-GHO
Under-5 mortality rate per 1,000 live births *	2015-19	WHO-GHO
DALYs for all causes per 100,000 population *	2015-19	IHME-GBD
DALYs for NCDs per 100,000 population *	2015-19	IHME-GBD
DALYs for maternal causes per 100,000 population *	2015-19	IHME-GBD
DALYs for neonatal causes per 100,000 population *	2015-19	IHME-GBD
Service coverage		
UHC service coverage index	2017, 2019	WHO-GHO
UHC index on service capacity on access	2017, 2019	WHO-GHO
UHC index on non-communicable diseases	2017, 2019	WHO-GHO
UHC index on reproductive, maternal, newborn, and child health	2017, 2019	WHO-GHO
UHC index on infectious diseases	2017, 2019	WHO-GHO
Access to services		
Skilled birth attendance (%)	2015-19	WHO-GHO
DPT immunization rate (% of children aged 12-23 months)	2015-19	WHO-GHO
Equity		
Skilled birth attendance ratio poorest/richest wealth quintiles	Recent	WHO-GHO
Skilled birth attendance ratio rural/urban areas	Recent	WHO-GHO
Explanatory variables		
Out-of-pocket as a % of total expenditure	2015-19	WHO-GHED
Hospital beds per 1,000 people	2015-19	WHO-GHO
Average governance quality (1)	2015-19	WB-WGI

Source: Prepared by authors.

Notes: The explanatory variables correspond to variables used in regression on potential determinants. We included indicators from the Institute of Health Metrics and Evaluation (IHME) Global Burden of Disease (GBD), the World Health Organization (WHO) Global Health Expenditure Database (GHED), the WHO Global Health Observatory (GHO), and the World Bank (WB) Worldwide Governance Indicators (WGI) project. (*) For these indicators, we use the inverse of the variable as we want to reflect a "more is better". (1) The "average governance quality" corresponds to the average of sex governance quality indicators: control of corruption, government effectiveness, political stability and absence of violence/terrorism, regulatory and rule of law.

Appendix B. Descriptive statistics

Figure B1. Correlation chart



Source: Author's calculations.

Table B1. Sample averages by country, 2015-2019

Country	Life expectancy at birth	HALE at birth	Under-5 mortality rate	Neonatal mortality rate	DALYs lost per 100,000 people				UHC services coverage index					Births attended by skilled health staff	DPT immunization DPT (%)	Ratio skilled birth attendance		Out-of-pocket as a % of CHE	Hospital beds per 1,000 people	Average governance quality
					All causes	*NCDs*	*Maternal causes*	*Neonatal causes*	*Total*	*Service capacity*	*NCDs*	*RMNC health*	*Infectious diseases*			*Poor / Rich*	*Rural / Urban*			
ARG	76.42	66.70	10.29	6.10	27,868	21,307	61	862	73.70	85.72	48.80	88.33	79.86	98.30	88.20	0.996		27.21	4.97	-0.07
BHS	73.60	64.47	15.29	7.17	31,089	22,429	65	793	68.51	63.84	52.39	84.15	78.34	98.75	92.40			27.32	2.90	0.65
BLZ	74.38	65.01	13.74	9.12	25,865	16,030	101	1,637	65.41	53.18	65.97	80.02	65.25	95.14	94.20	0.936	0.977	23.58	1.13	-0.27
BOL	71.66	62.81	28.70	15.28	31,334	18,671	302	3,425	65.60	62.76	73.84	70.17	57.31	86.57	83.60	0.346	0.550	25.31	1.23	-0.64
BRA	75.41	64.76	15.64	9.37	30,440	21,316	66	1,657	75.16	95.46	55.36	76.24	79.28	98.68	86.20	0.744	0.806	24.66	2.12	-0.20
BRB	76.45	66.94	13.34	8.86	32,260	26,692	38	1,001	73.72	80.63	57.66	85.91	73.97	98.78	93.80	1.000	1.017	45.30	5.92	0.90
CHL	79.96	69.11	7.44	4.84	24,529	20,018	25	492	78.28	90.72	56.82	90.09	80.90	99.76	95.00			33.72	2.11	0.94
COL	79.96	69.39	14.57	7.93	24,069	16,741	77	1,184	77.18	85.76	71.98	81.82	70.27	98.28	92.00	0.888	0.898	15.14	1.68	-0.19
CRI	79.96	69.31	8.65	6.04	22,776	17,693	33	689	76.26	73.53	68.07	87.32	77.45	97.00	94.80	1.013	0.997	22.16	1.13	0.61
DOM	72.53	63.72	34.81	24.27	31,230	19,726	158	3,422	64.06	59.08	52.06	83.74	65.41	99.62	86.40	0.973	0.990	28.92	1.52	-0.21
ECU	76.07	66.48	14.38	6.99	25,087	16,941	110	1,442	78.28	83.99	76.28	80.79	72.73	95.39	83.20	0.424	0.632	32.65	1.48	-0.47
GTM	72.20	62.60	26.38	12.42	29,063	16,854	174	1,760	56.73	32.98	67.68	70.27	66.21	69.70	82.80	0.413	0.681	55.89	0.43	-0.62
GUY	66.87	58.02	31.19	19.04	40,501	25,784	204	2,721	73.29	79.75	58.98	82.05	74.79	95.75	96.60	0.953	0.997	32.20	1.72	-0.24
HND	71.43	62.54	18.00	9.79	26,896	17,478	165	1,880	61.27	37.41	68.87	80.01	68.50	79.78	92.40	0.830	0.920	50.91	0.65	-0.64
HTI	63.00	54.75	66.01	26.18	49,856	23,319	794	4,666	45.83	25.47	63.82	50.71	53.67	41.60	61.40	0.186	0.498	37.63		-1.19
JAM	76.25	66.56	14.61	10.32	26,672	20,644	67	1,746	69.00	75.21	54.35	86.32	64.27	99.70	95.20	0.965	0.983	17.37	1.73	0.20
MEX	75.56	65.33	15.17	8.51	26,752	19,748	61	1,216	73.24	77.44	64.80	82.57	69.48	97.43	87.00	0.920	0.943	41.76	0.99	-0.36
NIC	75.06	65.53	17.97	10.85	22,494	16,294	63	1,180	68.62	68.60	67.74	76.05	62.82	94.07	98.00	0.635	0.766	34.14	0.93	-0.73
PAN	79.65	68.97	15.92	8.87	23,295	16,426	89	1,120	75.43	89.89	66.22	81.31	66.93	94.60	83.20	0.721	0.786	33.98	2.27	0.14
PER	79.82	69.58	14.45	7.49	22,322	14,792	101	1,626	77.38	77.51	82.69	76.42	73.37	93.14	86.80	0.776	0.816	29.12	1.58	-0.13
PRY	76.40	66.30	20.90	11.17	24,425	17,188	105	1,030	60.06	60.31	36.74	84.82	69.39	96.70	89.80	0.879	0.920	43.27	0.81	-0.40
SLV	75.07	65.00	14.36	6.98	28,950	18,876	53	989	74.13	75.79	71.39	81.52	68.49	99.90	86.20	0.944	0.966	36.08	1.09	-0.29
SUR	72.53	62.78	19.23	11.97	33,699	23,194	128	2,571	67.22	71.02	55.91	72.59	70.94	94.20	75.00	0.972	0.988	20.81	3.02	-0.17
TTO	74.85	65.20	18.26	11.68	32,583	25,437	39	1,127	72.44	78.21	53.83	81.14	80.66	100.00	94.80	1.004	0.989	43.41	3.02	0.09
URY	77.35	67.38	7.82	4.44	30,751	24,639	28	580	78.57	92.79	52.69	92.64	84.18	99.98	93.60	1.011	0.984	16.31	2.45	0.88
VEN	75.46	65.73	23.20	14.60	28,579	19,152	134	1,525	69.68	69.21	64.02	77.58	68.70	99.10	72.20			29.58	0.82	-1.61
LAC	**74.92**	**65.19**	**19.24**	**10.78**	**28,976**	**19,900**	**125**	**1,628**	**69.96**	**71.01**	**61.88**	**80.18**	**70.89**	**93.15**	**87.88**	**0.806**	**0.868**	**31.86**	**1.91**	**-0.15**
MICS	**70.80**	**61.87**	**29.94**	**14.57**	**34,649**	**21,013**	**189**	**2,507**	**60.71**	**60.35**	**56.07**	**71.69**	**61.70**	**89.60**	**87.86**	**0.750**	**0.846**	**35.94**	**2.36**	**-0.32**
OECD	**80.78**	**69.64**	**4.81**	**2.77**	**28,501**	**24,258**	**13**	**373**	**81.01**	**92.37**	**62.73**	**89.55**	**83.72**	**98.75**	**94.94**	**0.937**	**0.947**	**20.18**	**4.49**	**1.07**
Total	**73.47**	**63.96**	**23.15**	**11.42**	**33,096**	**22,005**	**141**	**1,918**	**66.23**	**69.11**	**57.63**	**76.66**	**67.81**	**92.01**	**89.63**	**0.759**	**0.850**	**31.86**	**3.35**	**0.07**

Source: Author's calculations.

Notes: The data for health outcomes, access to services and the explanatory variables are averages between 2015-2019; the service coverage is an average between 2017 and 2019 and the equity measures use the most recent data available.

Appendix C. Additional results

Table C1. Efficiency score by output indicator, 2015-2019

Country	Life expectancy at birth	HALE at birth	Under-5 mortality rate	Neonatal mortality rate	DALYs lost per 100,000 people				UHC services coverage index					Births attended by skilled health staff	DPT immunization DPT (%)	Ratio skilled birth attendance	
					All causes	*NCDs*	*Maternal causes*	*Neonatal causes*	*Total*	*Service capacity*	*NCDs*	*RMNC health*	*Infectious diseases*			*Poor / Rich*	*Rural / Urban*
ARG	0.938	0.940	0.993	0.995	0.917	0.937	0.999	0.995	0.896	0.865	0.603	0.953	0.935	0.983	0.891	0.983	
BHS	0.910	0.915	0.988	0.994	0.860	0.901	0.999	0.995	0.837	0.640	0.634	0.924	0.939	0.988	0.933		
BLZ	0.974	0.978	0.997	0.996	0.945	0.969	0.999	0.992	0.899	0.596	0.842	0.950	0.828	0.951	0.952	0.935	0.964
BOL	0.931	0.937	0.982	0.989	0.868	0.940	0.997	0.972	0.887	0.695	0.934	0.826	0.723	0.866	0.844	0.345	0.543
BRA	0.941	0.927	0.990	0.993	0.889	0.925	0.999	0.988	0.941	0.975	0.671	0.860	0.978	0.987	0.871	0.741	0.793
BRB	0.967	0.968	0.993	0.994	0.921	0.930	1.000	0.994	0.945	0.851	0.743	0.980	0.960	0.989	0.948	0.999	1.000
CHL	0.981	0.974	0.996	0.996	0.965	0.952	1.000	0.998	0.946	0.912	0.705	0.973	0.941	0.998	0.960		
COL	0.996	0.992	0.991	0.994	0.952	0.973	0.999	0.992	0.965	0.875	0.870	0.920	0.851	0.983	0.929	0.880	0.883
CRI	0.986	0.982	0.995	0.995	0.972	0.968	1.000	0.996	0.933	0.744	0.829	0.951	0.914	0.970	0.958	1.000	0.979
DOM	0.907	0.915	0.971	0.979	0.866	0.930	0.999	0.970	0.802	0.603	0.630	0.945	0.814	0.996	0.873	0.970	0.974
ECU	0.960	0.963	0.993	0.996	0.947	0.970	0.999	0.990	1.000	0.887	0.931	0.927	0.899	0.954	0.840	0.422	0.622
GTM	0.944	0.942	0.987	0.994	0.929	0.959	0.999	0.993	0.793	0.367	0.868	0.832	0.872	0.697	0.837	0.413	0.675
GUY	0.848	0.845	0.977	0.985	0.751	0.859	0.998	0.978	0.954	0.836	0.725	0.945	0.942	0.958	0.976	0.951	0.983
HND	0.953	0.960	0.998	0.997	0.968	0.951	0.999	0.994	0.870	0.431	0.897	0.994	0.921	0.799	0.939	0.836	0.911
HTI	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.784	1.000	1.000	1.000	0.678	0.815	0.499	0.889
JAM	0.976	0.977	0.995	0.994	0.931	0.925	1.000	0.988	0.908	0.811	0.674	1.000	0.806	0.997	0.962	0.962	0.969
MEX	0.943	0.935	0.990	0.994	0.928	0.935	0.999	0.992	0.912	0.787	0.784	0.920	0.856	0.974	0.879	0.916	0.926
NIC	0.999	1.000	0.995	0.995	1.000	0.977	1.000	0.998	0.972	0.788	0.882	0.940	0.830	0.942	0.995	0.638	0.758
PAN	0.972	0.968	0.987	0.992	0.947	0.972	0.999	0.991	0.901	0.900	0.801	0.878	0.777	0.946	0.840	0.711	0.772
PER	1.000	1.000	0.993	1.000	1.000	0.993	0.999	0.988	0.990	0.809	1.000	0.875	0.926	0.931	0.877	0.775	0.804
PRY	0.956	0.952	0.986	0.992	0.947	0.958	0.999	0.994	0.761	0.623	0.444	0.967	0.865	0.967	0.907	0.876	0.906
SLV	0.977	0.969	0.996	0.997	0.928	0.970	1.000	0.997	1.000	0.840	0.914	0.981	0.869	1.000	0.871	0.943	0.953
SUR	0.900	0.894	0.984	0.989	0.822	0.890	0.999	0.978	0.831	0.722	0.676	0.802	0.852	0.942	0.758	0.964	0.971
TTO	0.927	0.927	0.985	0.990	0.860	0.878	1.000	0.992	0.888	0.787	0.656	0.893	0.973	1.000	0.958	0.996	0.971
URY	0.952	0.953	0.995	0.997	0.918	0.926	1.000	0.997	0.962	0.942	0.680	1.000	0.990	1.000	0.945	1.000	0.966
VEN	0.944	0.944	0.983	0.989	0.905	0.940	0.999	0.989	0.873	0.707	0.774	0.876	0.858	0.991	0.729		
Including all countries																	
LAC	0.953	0.952	0.990	0.993	0.920	0.944	0.999	0.991	0.910	0.761	0.776	0.927	0.889	0.942	0.896	0.815	0.873
MICS	0.932	0.936	0.985	0.993	0.880	0.937	0.999	0.987	0.865	0.691	0.728	0.884	0.834	0.927	0.901	0.801	0.868
OECD	0.972	0.964	0.998	0.998	0.938	0.938	1.000	0.998	0.950	0.936	0.814	0.970	0.939	0.988	0.960	0.929	0.931
Total	0.942	0.943	0.989	0.994	0.894	0.937	0.999	0.990	0.888	0.758	0.749	0.908	0.864	0.943	0.916	0.807	0.871
Without Haiti																	
LAC	0.951	0.950	0.990	0.993	0.917	0.941	0.999	0.990	0.907	0.760	0.767	0.925	0.885	0.952	0.899	0.830	0.873
MICS	0.933	0.937	0.986	0.993	0.881	0.939	0.999	0.988	0.870	0.693	0.732	0.883	0.838	0.930	0.902	0.805	0.868
OECD	0.972	0.964	0.998	0.998	0.938	0.938	1.000	0.998	0.950	0.936	0.814	0.970	0.939	0.988	0.960	0.929	0.931
Total	0.943	0.943	0.989	0.994	0.895	0.938	0.999	0.991	0.891	0.759	0.751	0.907	0.867	0.945	0.916	0.810	0.870

Source: Author's calculations.

Notes: Average efficiency scores for MICS and OECD countries include countries in LAC. Total corresponds to the enlarged sample with LAC, MICS and OECD. Results from output-oriented DEA model using as input variables public health spending per capita, GDP per capita, and population aged 65 and above. Results without Haiti corresponds to re-running all the main analysis described in section "Methods and data" excluding Haiti.

Table C2. Efficiency score by output indicator, 2010-2014

Country	Life expectancy at birth	HALE at birth	Under-5 mortality rate	Neonatal mortality rate	DALYs lost per 100,000 people				UHC services coverage index					Births attended by skilled health staff	DPT immunization DPT (%)	Ratio skilled birth attendance	
					All causes	*NCDs*	*Maternal causes*	*Neonatal causes*	*Total*	*Service capacity*	*NCDs*	*RMNC health*	*Infectious diseases*			*Poor / Rich*	*Rural / Urban*
ARG	0.942	0.944	0.991	0.994	0.917	0.945	0.999	0.992	0.936	0.862	0.661	0.957	0.912	0.974	0.937		
BHS	0.918	0.920	0.990	0.994	0.874	0.917	0.999	0.994	0.830	0.596	0.673	0.935	0.819	0.989	0.986		
BLZ	0.959	0.958	0.994	0.995	0.956	0.980	0.999	0.990	0.914	0.582	0.887	0.956	0.858	0.940	0.968	0.910	0.958
BOL	0.917	0.918	0.974	0.985	0.859	0.946	0.997	0.968	0.814	0.746	0.960	0.799	0.470	0.836	0.911	0.345	0.548
BRA	0.941	0.923	0.989	0.992	0.872	0.927	0.999	0.983	0.991	0.968	0.671	0.874	1.000	0.987	0.976	0.739	0.793
BRB	0.966	0.967	0.991	0.993	0.918	0.928	1.000	0.993	0.992	0.831	0.772	0.918	0.883	0.993	0.907	0.993	1.000
CHL	0.985	0.978	0.996	0.996	0.968	0.959	1.000	0.997	0.947	0.907	0.674	0.957	0.906	0.998	0.933		
COL	1.000	0.991	0.989	0.994	0.948	0.982	0.999	0.989	0.939	0.831	0.886	0.894	0.673	0.981	0.899	0.850	0.870
CRI	1.000	0.995	0.995	0.995	0.988	0.984	1.000	0.995	0.956	0.701	0.818	0.926	0.928	0.982	0.909	0.963	0.962
DOM	0.928	0.929	0.973	0.979	0.885	0.952	0.999	0.966	0.825	0.578	0.667	0.939	0.728	0.987	0.871	0.988	0.970
ECU	0.957	0.953	0.991	0.995	0.936	0.970	0.999	0.987	1.000	0.871	0.965	0.918	0.756	0.914	0.881	0.422	0.621
GTM	0.923	0.914	0.980	0.991	0.910	0.966	0.998	0.989	0.854	0.471	0.898	0.872	0.855	0.613	0.905	0.413	0.680
GUY	0.849	0.841	0.974	0.983	0.765	0.871	0.998	0.977	0.979	0.806	0.755	0.878	0.979	0.938	0.972	0.792	0.895
HND	0.917	0.919	0.992	0.994	0.922	0.954	0.998	0.989	0.828	0.401	0.917	0.975	0.847	0.830	0.997	0.628	0.801
HTI	0.736	0.736	0.915	0.982	0.249	0.913	0.992	0.968	0.626	0.384	1.000	0.708	0.511	0.439	0.692	0.331	0.700
JAM	0.982	0.977	0.993	0.992	0.962	0.945	0.999	0.987	0.924	0.778	0.712	0.996	0.763	0.987	0.943	0.962	0.970
MEX	0.956	0.944	0.988	0.994	0.935	0.953	0.999	0.989	0.937	0.800	0.761	0.938	0.797	0.962	0.931		
NIC	0.972	0.972	0.991	0.993	1.000	0.978	1.000	0.997	0.916	0.743	0.898	0.989	0.684	0.903	0.996	0.641	0.770
PAN	0.977	0.973	0.985	0.991	0.939	0.977	0.999	0.991	0.920	0.867	0.821	0.922	0.714	0.932	0.861	0.713	0.773
PER	0.998	0.993	0.991	0.995	0.992	1.000	0.999	0.986	1.000	0.748	1.000	0.893	0.846	0.869	0.919	0.636	0.718
PRY	0.971	0.960	0.984	0.991	0.969	0.970	0.999	0.991	0.765	0.592	0.447	0.980	0.745	0.961	0.925	0.662	0.751
SLV	0.964	0.951	0.993	0.996	0.920	0.976	1.000	0.995	0.982	0.662	0.934	0.972	0.934	0.989	0.922	0.942	0.960
SUR	0.927	0.914	0.986	0.990	0.864	0.916	0.999	0.975	0.870	0.708	0.697	0.847	0.776	0.900	0.802	0.870	0.876
TTO	0.940	0.934	0.984	0.988	0.866	0.894	1.000	0.991	0.908	0.760	0.702	0.846	0.924	0.995	0.921	0.996	0.972
URY	0.960	0.957	0.995	0.997	0.924	0.946	1.000	0.996	1.000	0.955	0.708	1.000	0.898	0.995	0.958	1.000	0.971
VEN	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
LAC	**0.945**	**0.941**	**0.985**	**0.992**	**0.898**	**0.952**	**0.999**	**0.988**	**0.910**	**0.736**	**0.803**	**0.919**	**0.816**	**0.919**	**0.920**	**0.752**	**0.836**
MICS	**0.900**	**0.901**	**0.975**	**0.990**	**0.823**	**0.939**	**0.998**	**0.979**	**0.786**	**0.637**	**0.756**	**0.846**	**0.642**	**0.874**	**0.909**	**0.755**	**0.840**
OECD	**0.976**	**0.967**	**0.998**	**0.998**	**0.938**	**0.939**	**1.000**	**0.998**	**0.958**	**0.932**	**0.810**	**0.960**	**0.887**	**0.989**	**0.965**	**0.911**	**0.922**
Total	**0.921**	**0.919**	**0.981**	**0.992**	**0.854**	**0.938**	**0.999**	**0.984**	**0..834**	**0.719**	**0.770**	**0.878**	**0.714**	**0.904**	**0.924**	**0.764**	**0.845**

Source: Author's calculations.

Notes: Average efficiency scores for MICS and OECD countries include countries in LAC. Total corresponds to the enlarged sample with LAC, MICS, and OECD. Results from output-oriented DEA model using as input variables public health spending per capita, GDP per capita, and population aged 65 and above.

Table C3. Potential gains due to efficient health spending by output indicator, 2015-2019

Country	Life expectancy at birth	HALE at birth	Under-5 mortality rate	Neonatal mortality rate	DALYs lost per 100,000 people				UHC services coverage index					Births attended by skilled health staff	DPT immunization DPT (%)	Ratio skilled birth attendance	
					All causes	*NCDs*	*Maternal causes*	*Neonatal causes*	*Total*	*Service capacity*	*NCDs*	*RMNC health*	*Infectious diseases*			*Poor / Rich*	*Rural / Urban*
ARG	4.72	3.99	7.14	4.82	5,967	4,974	55	544	7.69	11.60	19.38	4.11	5.22	1.67	9.62	0.02	
BHS	6.61	5.48	11.71	5.81	9,620	7,691	58	459	11.16	23.00	19.20	6.38	4.76	1.23	6.16		
BLZ	1.92	1.41	2.53	4.23	4,110	2,642	71	797	6.64	21.47	10.41	3.98	11.20	4.62	4.53	0.06	0.04
BOL	4.94	3.97	17.90	10.59	9,048	4,879	275	2,658	7.41	19.17	4.90	12.18	15.89	11.63	13.00	0.23	0.25
BRA	4.44	4.70	9.55	6.78	7,695	5,930	55	1,228	4.40	2.38	18.21	10.71	1.76	1.30	11.15	0.19	0.17
BRB	2.50	2.17	7.27	5.67	5,365	5,160	25	563	4.04	12.05	14.84	1.69	2.95	1.13	4.86	0.00	0.00
CHL	1.53	1.81	4.40	3.58	2,644	3,815	19	196	4.22	7.97	16.77	2.39	4.75	0.24	3.84		
COL	0.29	0.55	9.18	5.54	3,673	2,215	70	778	2.70	10.69	9.32	6.56	10.49	1.69	6.51	0.11	0.10
CRI	1.09	1.27	5.42	4.73	2,129	2,607	27	355	5.09	18.84	11.65	4.30	6.67	2.91	4.02	0.00	0.02
DOM	6.72	5.44	28.00	20.68	9,213	5,602	145	2,881	12.66	23.44	19.28	4.63	12.14	0.38	11.00	0.03	0.03
ECU	3.06	2.48	6.42	3.52	3,967	2,517	95	973	0.00	9.51	5.26	5.91	7.32	4.40	13.28	0.25	0.24
GTM	4.02	3.60	13.12	6.32	5,022	3,401	145	715	11.72	20.88	8.95	11.77	8.48	21.12	13.46	0.24	0.22
GUY	10.19	9.02	22.69	14.77	14,832	10,496	187	2,108	3.40	13.05	16.24	4.50	4.33	4.07	2.34	0.05	0.02
HND	3.39	2.51	2.20	3.04	2,351	4,034	128	561	7.98	21.29	7.11	0.47	5.38	16.03	5.62	0.14	0.08
HTI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.50	0.00	0.00	0.00	13.40	11.37	0.09	0.06
JAM	1.85	1.52	5.37	6.27	5,081	5,939	47	1,173	6.33	14.18	17.71	0.00	12.44	0.30	3.65	0.04	0.03
MEX	4.34	4.25	9.98	6.01	5,294	5,230	50	792	6.47	16.50	14.02	6.57	10.00	2.50	10.55	0.08	0.07
NIC	0.09	0.00	4.60	5.10	0.00	1,967	26	228	1.92	14.54	8.00	4.56	10.66	5.41	0.45	0.23	0.19
PAN	2.20	2.22	12.82	7.59	4,055	2,343	83	849	7.43	9.00	13.19	9.95	14.94	5.11	13.28	0.21	0.18
PER	0.00	0.00	6.87	3.80	233	0.00	86	1,137	0.77	14.84	0.00	9.52	5.41	6.39	10.70	0.17	0.16
PRY	3.33	3.17	13.66	7.63	4,010	3,444	92	566	14.36	22.72	20.42	2.77	9.40	3.19	8.35	0.11	0.09
SLV	1.73	2.00	4.15	2.50	5,115	2,452	27	321	0.00	12.10	6.12	1.55	8.97	0.04	11.13	0.05	0.05
SUR	7.26	6.66	15.35	10.50	11,820	8,438	120	2,163	11.34	19.77	18.11	14.40	10.51	5.46	18.18	0.04	0.03
TTO	5.45	4.77	14.53	10.24	9,419	9,100	31	776	8.08	16.66	18.52	8.67	2.18	0.00	4.02	0.00	0.03
URY	3.71	3.20	4.69	3.17	5,689	5,564	22	264	2.98	5.40	16.87	0.00	0.86	0.02	5.11	0.00	0.03
VEN	4.21	3.71	16.90	11.31	6,806	4,859	121	1,060	8.85	20.30	14.45	9.64	9.76	0.89	19.55		
Including all countries																	
LAC	3.45	3.07	9.86	6.70	5,506	4,435	79	929	6.06	14.88	12.65	5.66	7.56	4.43	8.68	0.10	0.09
MICS	4.58	3.79	13.75	6.93	6,854	4,690	108	1,206	7.36	13.69	13.65	7.29	8.68	4.99	7.34	0.10	0.09
OECD	2.25	2.51	2.03	1.59	4,248	4,613	8	162	3.91	5.59	10.86	2.62	4.71	1.20	3.73	0.06	0.06
Total	4.00	3.48	10.65	5.56	6,238	4,738	81	916	6.50	11.54	13.03	6.00	7.53	3.97	6.48	0.09	0.08
Without Haiti																	
LAC	3.58	3.20	10.26	6.97	5,727	4,612	83	966	6.31	15.25	13.16	5.89	7.86	4.07	8.57	0.10	0.10
MICS	4.50	3.74	13.02	6.77	6,741	4,552	106	1,120	7.16	13.60	13.47	7.32	8.51	4.89	7.31	0.010	0.09
OECD	2.25	2.51	2.03	1.59	4,248	4,613	8	162	3.91	5.59	10.86	2.62	4.71	1.20	3.73	0.06	0.06
Total	3.95	3.44	10.12	5.44	6,161	4,638	80	857	6.36	11.48	12.90	6.02	7.41	3.89	6.46	0.09	0.08

Source: Author's calculations.

Notes: Average potential gains for MICS and OECD countries include countries in LAC. Total corresponds to the enlarged sample with LAC, MICS and OECD. Results from output-oriented DEA model using as input variables public health spending per capita, GDP per capita, and population aged 65 and above. Results without Haiti corresponds to re-running all the main analysis described in section "Methods and data" excluding Haiti.

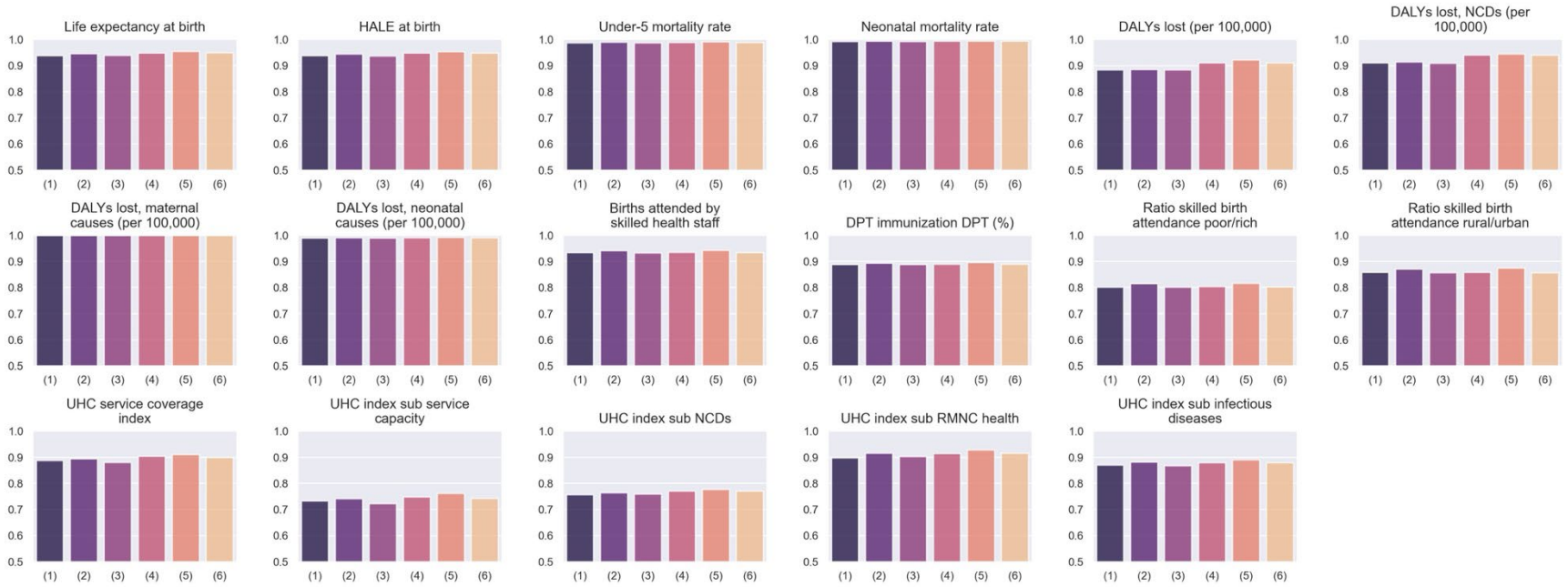
Table C4. Potential gains due to efficient health spending by output indicator (percent relative to baseline), 2015-2019

Country	Life expectancy at birth	HALE at birth	Under-5 mortality rate	Neonatal mortality rate	DALYs lost per 100,000 people				UHC services coverage index					Births attended by skilled health staff	DPT immunization DPT (%)	Ratio skilled birth attendance	
					All causes	*NCDs*	*Maternal causes*	*Neonatal causes*	*Total*	*Service capacity*	*NCDs*	*RMNC health*	*Infectious diseases*			*Poor / Rich*	*Rural / Urban*
ARG	6.18	5.98	69.33	79.12	21.41	23.35	90.18	63.13	10.43	13.54	39.71	4.66	6.54	1.70	10.91	1.65	
BHS	8.99	8.51	76.59	81.11	30.94	34.29	89.30	57.85	16.29	36.03	36.64	7.58	6.07	1.25	6.67		
BLZ	2.58	2.17	18.37	46.36	15.89	16.48	70.03	48.66	10.15	40.38	15.78	4.98	17.16	4.86	4.81	6.52	3.60
BOL	6.90	6.32	62.38	69.28	28.88	26.13	90.90	77.61	11.30	30.54	6.64	17.37	27.74	13.43	15.56	65.49	45.74
BRA	5.88	7.25	61.05	72.37	25.28	27.82	83.87	74.10	5.86	2.49	32.90	14.05	2.22	1.32	12.93	25.94	20.69
BRB	3.27	3.24	54.48	64.01	16.63	19.33	67.01	56.23	5.47	14.94	25.74	1.96	3.98	1.15	5.18	0.12	0.00
CHL	1.91	2.62	59.21	74.01	10.78	19.06	76.42	39.91	5.39	8.79	29.51	2.65	5.87	0.24	4.04		
COL	0.36	0.79	63.05	69.93	15.26	13.23	91.05	65.73	3.49	12.47	12.95	8.02	14.93	1.72	7.07	11.97	11.65
CRI	1.36	1.84	62.63	78.31	9.35	14.73	81.54	51.54	6.67	25.62	17.11	4.93	8.61	3.00	4.24	0.00	2.06
DOM	9.26	8.54	80.44	85.20	29.50	28.40	92.10	84.19	19.77	39.68	37.04	5.53	18.57	0.38	12.73	3.02	2.62
ECU	4.02	3.72	44.63	50.33	15.81	14.86	86.55	67.44	0.00	11.32	6.90	7.31	10.06	4.61	15.96	57.77	37.78
GTM	5.57	5.76	49.74	50.91	17.28	20.18	83.31	40.62	20.67	63.30	13.22	16.76	12.81	30.30	16.25	58.69	32.52
GUY	15.23	15.55	72.76	77.58	36.62	40.71	91.88	77.44	4.63	16.36	27.53	5.49	5.79	4.25	2.42	4.93	1.69
HND	4.74	4.01	12.20	31.03	8.74	23.08	77.54	29.84	13.03	56.91	10.32	0.59	7.85	20.09	6.09	16.43	8.87
HTI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.59	0.00	0.00	0.00	32.21	18.52	50.08	11.13
JAM	2.43	2.28	36.74	60.76	19.05	28.77	70.08	67.18	9.17	18.85	32.58	0.00	19.36	0.30	3.84	3.77	3.07
MEX	5.74	6.50	65.81	70.59	19.79	26.48	82.07	65.15	8.84	21.31	21.64	7.96	14.39	2.57	12.12	8.41	7.36
NIC	0.12	0.00	25.62	47.06	0.00	12.07	42.31	19.36	2.80	21.20	11.81	6.00	16.97	5.75	0.46	36.23	24.25
PAN	2.76	3.22	80.52	85.52	17.41	14.27	93.68	75.83	9.85	10.01	19.92	12.24	22.33	5.40	15.96	28.87	22.78
PER	0.00	0.00	47.56	50.66	1.04	0.00	85.64	69.92	0.99	19.15	0.00	12.46	7.38	6.86	12.32	22.54	19.65
PRY	4.36	4.78	65.36	68.35	16.42	20.04	87.20	54.99	23.91	37.68	55.57	3.27	13.54	3.30	9.29	12.37	9.39
SLV	2.30	3.07	28.91	35.86	17.67	12.99	51.47	32.40	0.00	15.97	8.57	1.90	13.10	0.04	12.91	5.66	4.67
SUR	10.02	10.61	79.80	87.67	35.07	36.38	94.23	84.12	16.88	27.84	32.39	19.84	14.82	5.80	24.24	3.64	2.93
TTO	7.28	7.31	79.55	87.68	28.91	35.78	80.05	68.91	11.15	21.30	34.40	10.68	2.70	0.00	4.24	0.39	2.87
URY	4.80	4.75	59.93	71.55	18.50	22.58	78.76	45.47	3.79	5.82	32.01	0.00	1.02	0.02	5.45	0.00	3.35
VEN	5.58	5.64	72.83	77.42	23.81	25.37	90.69	69.50	12.71	29.33	22.57	12.42	14.21	0.90	27.07		
Including all countries																	
LAC	**4.60**	**4.71**	**51.25**	**62.16**	**19.00**	**22.28**	**63.69**	**57.02**	**8.67**	**20.95**	**20.44**	**7.06**	**10.66**	**4.75**	**9.88**	**12.55**	**10.81**
MICS	**6.47**	**6.13**	**45.48**	**47.24**	**19.70**	**22.31**	**56.48**	**47.48**	**12.12**	**22.67**	**24.32**	**10.17**	**14.07**	**5.58**	**8.37**	**12.85**	**10.15**
OECD	**2.79**	**3.60**	**42.24**	**57.17**	**14.90**	**19.02**	**60.31**	**43.45**	**4.83**	**6.06**	**17.32**	**2.92**	**5.62**	**1.21**	**3.93**	**6.84**	**6.78**
Total	**5.45**	**5.44**	**45.77**	**48.52**	**18.81**	**21.51**	**56.89**	**47.39**	**9.81**	**16.68**	**22.59**	**7.82**	**11.11**	**4.32**	**7.23**	**12.43**	**9.96**

Source: Author's calculations.

Notes: Average potential gains for MICS and OECD countries include countries in LAC. Total corresponds to the enlarged sample with LAC, MICS and OECD. Results from output-oriented DEA model using as input variables public health spending per capita, GDP per capita, and population aged 65 and above. Results without Haiti corresponds to re-running all the main analysis described in section "Methods and data" excluding Haiti.

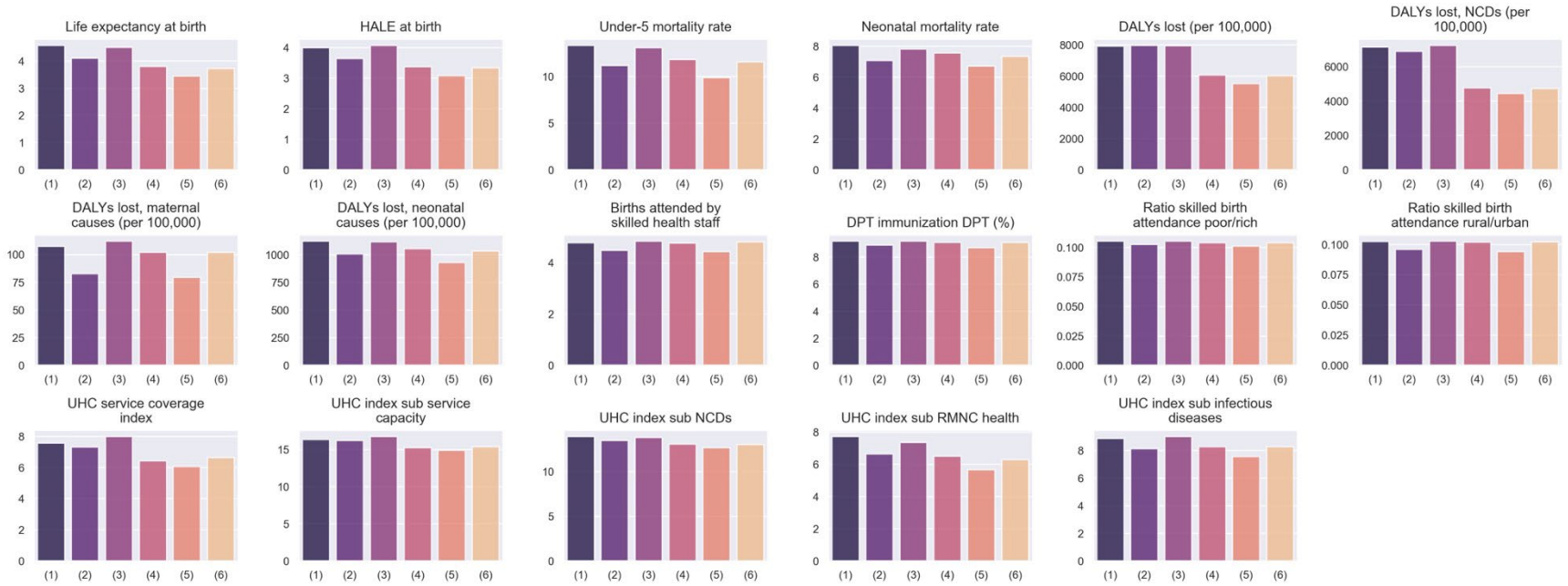
Figure C1. Comparison of efficiency scores due to efficient health spending by model in LAC, 2015-2019



Source: Author's calculations.

Notes: Figure C1 presents the efficiency score for output-oriented DEA models using different input variables. Model (1) use as input the total health expenditure per capita. Model (2) use as input the total public health expenditure per capita. Model (3) use as input the total public and private health expenditure per capita. Model (4) use as input the total health expenditure per capita, GPD per capita, and population aged 65 and above. Model (5) use as input the total public health expenditure per capita, GPD per capita, and population aged 65 and above. Model (6) use as input the total public and private health expenditure per capita, GPD per capita, and population aged 65 and above.

Figure C2. Comparison of potential gains due to efficient health spending by model in LAC, 2015-2019



Source: Author's calculations.

Notes: Figure C2 presents the potential gains for output-oriented DEA models using different input variables. Model (1) use as input the total health expenditure per capita. Model (2) use as input the total public health expenditure per capita. Model (3) use as input the total public and private health expenditure per capita. Model (4) use as input the total health expenditure per capita, GPD per capita, and population aged 65 and above. Model (5) use as input the total public health expenditure per capita, GPD per capita, and population aged 65 and above. Model (6) use as input the total public and private health expenditure per capita, GPD per capita, and population aged 65 and above.

Tabla C5. Comparison of efficiency scores due to efficient health spending by model and country for selected output indicators, 2015-2019

	Life expectancy at birth						Neonatal mortality rate						UHC service coverage index						Births attended by skilled health staff					
Country	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
ARG	0.93	0.93	0.93	0.94	0.94	0.94	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98	0.98	0.98	0.98	0.86	0.86	0.86	0.86	0.86	0.86
BHS	0.90	0.91	0.90	0.90	0.91	0.90	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.64	0.64	0.64	0.64	0.64	0.64
BLZ	0.96	0.95	0.95	0.97	0.97	0.97	1.00	0.99	0.99	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	0.95	0.57	0.55	0.55	0.60	0.60	0.60
BOL	0.91	0.90	0.90	0.93	0.93	0.93	0.99	0.99	0.99	0.99	0.99	0.99	0.87	0.87	0.87	0.87	0.87	0.87	0.66	0.64	0.65	0.69	0.69	0.69
BRA	0.93	0.94	0.93	0.94	0.94	0.94	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.96	0.97	0.96	0.98	0.98	0.98
BRB	0.95	0.96	0.95	0.96	0.97	0.96	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.82	0.82	0.82	0.84	0.85	0.85
CHL	0.97	0.98	0.98	0.98	0.98	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91	0.91	0.91	0.91
COL	0.99	0.99	0.99	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.98	0.98	0.98	0.98	0.98	0.98	0.87	0.86	0.86	0.88	0.88	0.88
CRI	0.99	0.98	0.98	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.97	0.97	0.97	0.97	0.97	0.74	0.74	0.74	0.74	0.74	0.74
DOM	0.91	0.91	0.91	0.91	0.91	0.91	0.98	0.98	0.98	0.98	0.98	0.98	1.00	1.00	1.00	1.00	1.00	1.00	0.60	0.60	0.60	0.60	0.60	0.60
ECU	0.95	0.95	0.95	0.96	0.96	0.96	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	0.95	0.85	0.85	0.85	0.89	0.89	0.89
GTM	0.92	0.94	0.94	0.94	0.94	0.94	0.99	0.99	0.99	0.99	0.99	0.99	0.70	0.70	0.70	0.70	0.70	0.70	0.35	0.35	0.35	0.37	0.37	0.37
GUY	0.85	0.85	0.85	0.85	0.85	0.85	0.98	0.98	0.98	0.98	0.98	0.98	0.96	0.96	0.96	0.96	0.96	0.96	0.83	0.82	0.83	0.84	0.84	0.84
HND	0.93	0.94	0.94	0.95	0.95	0.95	0.99	1.00	1.00	1.00	1.00	1.00	0.80	0.80	0.80	0.80	0.80	0.80	0.41	0.40	0.40	0.43	0.43	0.43
HTI	0.85	1.00	0.84	0.91	1.00	0.91	0.98	1.00	0.98	0.98	1.00	0.99	0.47	0.65	0.43	0.47	0.68	0.44	0.45	0.75	0.30	0.45	0.78	0.31
JAM	0.96	0.96	0.95	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.77	0.77	0.81	0.81	0.81
MEX	0.94	0.94	0.94	0.94	0.94	0.94	0.99	0.99	0.99	0.99	0.99	0.99	0.97	0.97	0.97	0.97	0.97	0.97	0.78	0.79	0.79	0.78	0.79	0.79
NIC	0.96	0.96	0.96	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.94	0.94	0.94	0.94	0.94	0.94	0.73	0.71	0.71	0.79	0.79	0.79
PAN	0.97	0.97	0.97	0.97	0.97	0.97	0.99	0.99	0.99	0.99	0.99	0.99	0.95	0.95	0.95	0.95	0.95	0.95	0.90	0.90	0.90	0.90	0.90	0.90
PER	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.93	0.93	0.93	0.93	0.93	0.80	0.79	0.79	0.81	0.81	0.81
PRY	0.95	0.96	0.96	0.96	0.96	0.96	0.99	0.99	0.99	0.99	0.99	0.99	0.97	0.97	0.97	0.97	0.97	0.97	0.61	0.62	0.62	0.62	0.62	0.62
SLV	0.94	0.94	0.94	0.98	0.98	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.77	0.77	0.77	0.84	0.84	0.84
SUR	0.90	0.90	0.90	0.90	0.90	0.90	0.99	0.99	0.99	0.99	0.99	0.99	0.94	0.94	0.94	0.94	0.94	0.94	0.72	0.71	0.71	0.72	0.72	0.72
TTO	0.92	0.93	0.93	0.92	0.93	0.93	0.99	0.99	0.99	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.79	0.78	0.79	0.79	0.79
URY	0.95	0.94	0.94	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.93	0.93	0.94	0.94	0.94
VEN	0.94	0.94	0.94	0.94	0.94	0.94	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.71	0.71	0.70	0.71	0.71	0.70
LAC	0.94	0.94	0.94	0.95	0.95	0.95	0.99	0.99	0.99	0.99	0.99	0.99	0.93	0.94	0.93	0.93	0.94	0.93	0.73	0.74	0.72	0.75	0.76	0.74
MICS	0.91	0.91	0.91	0.93	0.93	0.93	0.99	0.99	0.99	0.99	0.99	0.99	0.91	0.92	0.91	0.92	0.93	0.92	0.68	0.66	0.65	0.70	0.69	0.68
OECD	0.97	0.97	0.97	0.97	0.97	0.97	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.93	0.93	0.93	0.94	0.94	0.94
Total	0.93	0.93	0.92	0.94	0.94	0.94	0.99	0.99	0.99	0.99	0.99	0.99	0.93	0.94	0.93	0.94	0.94	0.94	0.75	0.73	0.72	0.77	0.76	0.75

Source: Author's calculations.

Notes: Average efficiency scores for MICS and OECD countries include countries in LAC. Table C4 presents the efficiency score for output-oriented DEA models using different input variables. Model (1) use as input the total health expenditure per capita. Model (2) use as input the total public health expenditure per capita. Model (3) use as input the total public and private health expenditure per capita. Model (4) use as input the total health expenditure per capita, GPD per capita, and population aged 65 and above. Model (5) use as input the total public health expenditure per capita, GPD per capita, and population aged 65 and above. Model (6) use as input the total public and private health expenditure per capita, GPD per capita, and population aged 65 and above.

Tabla C6. Comparison of potential gains due to efficient health spending by model and country for selected output indicators, 2015-2019

	Life expectancy at birth						Neonatal mortality rate						UHC service coverage index						Births attended by skilled health staff					
Country	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
ARG	5.28	5.30	5.27	4.84	4.72	4.79	4.90	4.86	4.89	4.82	4.82	4.82	9.04	9.42	9.43	7.69	7.69	7.69	1.67	1.67	1.67	1.67	1.67	1.67
BHS	7.36	6.61	7.36	7.36	6.61	7.36	5.92	5.81	5.92	5.92	5.81	5.92	12.22	11.16	12.54	12.22	11.16	12.54	1.23	1.23	1.23	1.23	1.23	1.23
BLZ	3.03	3.72	3.59	1.91	1.92	1.92	4.56	5.03	5.05	4.23	4.23	4.23	7.24	8.79	8.81	6.41	6.64	6.64	4.62	4.62	4.62	4.62	4.62	4.62
BOL	6.52	7.20	6.86	4.94	4.94	4.94	11.20	11.63	11.59	10.59	10.59	10.59	9.41	10.83	10.40	7.31	7.41	7.41	11.63	11.63	11.63	11.63	11.63	11.63
BRA	5.08	4.52	5.07	4.48	4.44	4.48	8.00	7.01	8.00	6.82	6.78	6.82	5.86	4.94	6.15	4.40	4.40	4.40	1.30	1.30	1.30	1.30	1.30	1.30
BRB	3.77	3.43	3.45	2.79	2.50	2.68	7.43	6.02	6.32	6.77	5.67	6.21	6.34	5.86	5.93	3.82	4.04	3.96	1.21	1.21	1.21	1.18	1.13	1.15
CHL	2.06	1.87	1.79	1.87	1.53	1.51	3.65	3.59	3.61	3.62	3.58	3.59	5.32	5.34	5.24	4.37	4.22	4.15	0.24	0.24	0.24	0.24	0.24	0.24
COL	0.61	0.94	0.88	0.29	0.29	0.29	6.55	6.57	6.58	5.54	5.54	5.54	3.60	4.48	4.40	2.70	2.70	2.70	1.69	1.69	1.69	1.69	1.69	1.69
CRI	1.12	1.47	1.26	1.05	1.09	1.03	4.74	4.75	4.76	4.73	4.73	4.73	5.35	6.29	5.95	4.99	5.09	5.02	2.91	2.91	2.91	2.91	2.91	2.91
DOM	6.74	6.72	6.74	6.74	6.72	6.74	20.81	20.68	20.96	20.81	20.68	20.96	12.60	12.66	12.73	12.60	12.66	12.73	0.38	0.38	0.38	0.38	0.38	0.38
ECU	3.90	3.87	3.83	3.06	3.06	3.06	4.72	4.44	4.59	3.52	3.52	3.52	1.84	1.96	1.92	0.00	0.00	0.00	4.40	4.40	4.40	4.40	4.40	4.40
GTM	5.57	4.02	4.19	4.42	4.02	4.19	8.13	6.61	7.12	7.75	6.32	6.60	13.93	11.72	12.22	12.94	11.72	12.22	21.12	21.12	21.12	21.12	21.12	21.12
GUY	10.08	10.19	9.98	10.08	10.19	9.98	14.82	14.98	14.96	14.82	14.77	14.75	2.95	3.40	3.13	2.68	3.40	3.13	4.07	4.07	4.07	4.07	4.07	4.07
HND	5.31	4.57	4.59	3.39	3.39	3.39	5.05	3.68	3.82	3.85	3.04	3.11	9.61	8.53	8.84	7.98	7.98	7.98	16.13	16.13	16.13	16.03	16.03	16.03
HTI	9.63	0.00	10.01	5.89	0.00	5.89	17.82	0.00	14.65	15.93	0.00	13.62	7.85	0.00	13.79	7.64	0.00	12.62	22.20	14.51	23.78	22.07	13.40	23.41
JAM	2.98	3.37	3.48	1.85	1.85	1.85	6.56	6.81	7.24	6.30	6.27	6.30	7.82	8.60	9.35	6.03	6.33	6.55	0.30	0.30	0.30	0.30	0.30	0.30
MEX	4.60	4.34	4.34	4.60	4.34	4.34	7.12	6.01	6.32	7.12	6.01	6.32	6.80	6.47	6.52	6.80	6.47	6.52	2.50	2.50	2.50	2.50	2.50	2.50
NIC	2.77	3.02	2.70	0.09	0.09	0.09	6.44	6.69	6.62	5.10	5.10	5.10	5.38	6.12	5.78	1.92	1.92	1.92	5.58	5.58	5.58	5.41	5.41	5.41
PAN	2.45	2.25	2.15	2.38	2.20	2.09	7.65	7.59	7.61	7.64	7.59	7.60	7.84	7.86	7.72	7.50	7.43	7.39	5.11	5.11	5.11	5.11	5.11	5.11
PER	0.00	0.00	0.00	0.00	0.00	0.00	3.98	4.03	4.20	3.98	3.80	3.92	1.51	1.50	1.80	0.40	0.77	0.84	6.39	6.39	6.39	6.39	6.39	6.39
PRY	3.62	3.33	3.39	3.39	3.33	3.37	8.94	7.81	8.20	8.17	7.63	7.93	15.09	14.82	14.92	14.52	14.36	14.51	3.19	3.19	3.19	3.19	3.19	3.19
SLV	4.59	4.52	4.50	1.73	1.73	1.73	3.94	3.66	3.78	2.50	2.50	2.50	5.21	5.13	5.13	0.00	0.00	0.00	0.10	0.10	0.10	0.04	0.04	0.04
SUR	7.24	7.44	7.38	7.22	7.26	7.26	10.53	10.54	10.54	10.50	10.50	10.50	11.43	11.94	11.88	11.28	11.34	11.34	5.46	5.46	5.46	5.46	5.46	5.46
TTO	5.87	5.45	5.44	5.87	5.45	5.44	10.31	10.24	10.25	10.30	10.24	10.25	8.64	8.08	8.11	8.61	8.08	8.11	0.00	0.00	0.00	0.00	0.00	0.00
URY	4.20	4.34	4.43	4.00	3.71	3.94	3.22	3.20	3.24	3.17	3.17	3.17	4.54	5.21	5.47	2.98	2.98	2.98	0.02	0.02	0.02	0.02	0.02	0.02
VEN	4.38	4.21	4.38	4.38	4.21	4.38	12.00	11.31	12.10	12.00	11.31	12.10	9.03	8.85	9.19	9.03	8.85	9.19	0.89	0.89	0.89	0.89	0.89	0.89
LAC	4.57	4.10	4.50	3.79	3.45	3.72	8.04	7.06	7.80	7.56	6.70	7.33	7.56	7.31	7.97	6.42	6.06	6.64	4.78	4.49	4.84	4.76	4.43	4.81
MICS	6.06	6.04	6.20	4.72	4.58	4.67	9.71	8.05	8.66	8.30	6.93	7.27	8.83	9.27	9.79	7.39	7.36	7.64	5.79	5.64	5.98	5.51	4.99	5.30
OECD	2.47	2.51	2.45	2.23	2.25	2.21	1.73	1.69	1.71	1.66	1.59	1.61	4.91	5.27	5.09	3.75	3.91	3.67	1.21	1.21	1.21	1.20	1.20	1.20
Total	5.15	5.12	5.23	4.12	4.00	4.06	7.59	6.38	6.83	6.56	5.56	5.81	7.86	8.25	8.59	6.49	6.50	6.64	4.56	4.46	4.70	4.35	3.97	4.20

Source: Author's calculations.

Notes: Average potential gains for MICS and OECD countries include countries in LAC. Table C5 presents the potential gains for output-oriented DEA models using different input variables. Model (1) use as input the total health expenditure per capita. Model (2) use as input the total public health expenditure per capita. Model (3) use as input the total public and private health expenditure per capita. Model (4) use as input the total health expenditure per capita, GPD per capita, and population aged 65 and above. Model (5) use as input the total public health expenditure per capita, GPD per capita, and population aged 65 and above. Model (6) use as input the total public and private health expenditure per capita, GPD per capita, and population aged 65 and above.

Appendix D. Potential determinants of efficiency

Table D1. Potential determinants of efficiency, 2015-2019

	Life expectancy at birth	HALE at birth	DALYs lost per 100,000 people		UHC services coverage index					Births attended by skilled health staff	DPT immunization (%)	Ratio skilled birth attendance	
			All causes	*NCDs*	*Total*	*Service capacity*	*NCDs*	*RMNC health*	*Infectious diseases*			*Poor / Rich*	*Rural / Urban*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Enlarged sample													
OOP health expenditure as % of CHE	0.000	0.000	0.000	0.000	-0.001	-0.004*	0.000	0.001	-0.004	-0.010	0.001	0.032	0.048*
	0.000	0.000	(0.001)	0.000	(0.001)	(0.002)	(0.001)	(0.001)	(0.004)	(0.006)	(0.001)	(0.020)	(0.029)
Hospital beds per 1.000 people	-0.005*	-0.001	-0.010**	-0.008***	-0.005	0.060**	-0.017***	0.001	-0.013	0.334*	0.014	1.889**	1.348**
	(0.003)	(0.002)	(0.004)	(0.002)	(0.006)	(0.024)	(0.007)	(0.009)	(0.026)	(0.179)	(0.009)	(0.757)	(0.594)
Average governance quality	0.023***	0.014**	0.035**	0.010	0.061***	0.117***	0.048**	0.128***	0.267**	0.089	0.073***	0.978	2.023*
	(0.008)	(0.007)	(0.014)	(0.007)	(0.019)	(0.045)	(0.021)	(0.041)	(0.134)	(0.116)	(0.024)	(0.770)	(1.157)
Constant	0.979***	0.950***	0.954***	0.957***	0.970***	0.852***	0.823***	0.940***	1.268***	1.341***	0.880***	-1.201	-0.220
	(0.019)	(0.015)	(0.031)	(0.017)	(0.043)	(0.091)	(0.045)	(0.060)	(0.307)	(0.348)	(0.043)	(1.063)	(0.873)
Observations	77	78	79	82	75	78	83	74	80	66	74	36	36
Model chi-squared	13.825	5.566	10.395	14.188	16.398	28.870	10.832	10.716	4.675	4.220	13.260	6.230	5.253
Model significance, p-value	0.003	0.135	0.015	0.003	0.001	0.000	0.013	0.013	0.197	0.239	0.004	0.101	0.154
LAC													
OOP health expenditure as % of CHE	0.000	-0.002	0.001	0.000	-0.001	-0.003	0.001	0.001	0.004*	-0.005	0.001	0.012	0.001
	(0.002)	(0.006)	(0.002)	(0.001)	(0.002)	(0.003)	(0.004)	(0.002)	(0.002)	(0.006)	(0.001)	(0.036)	(0.007)
Hospital beds per 1.000 people	-0.004	-0.019	-0.014	-0.014	-0.006	0.036	-0.040	-0.014	0.013	0.033	-0.020	0.344	-0.060
	(0.014)	(0.141)	(0.023)	(0.011)	(0.024)	(0.032)	(0.032)	(0.014)	(0.022)	(0.094)	(0.014)	(0.719)	(0.148)
Average governance quality	0.007	0.040	0.028	0.020	0.055	0.016	-0.056	0.049*	0.038	0.069	0.154***	0.941	0.718
	(0.030)	(0.387)	(0.053)	(0.026)	(0.045)	(0.062)	(0.076)	(0.029)	(0.036)	(0.103)	(0.035)	(2.282)	(0.610)
Constant	0.963***	1.079	0.956***	1.007***	1.007***	0.864***	0.863***	0.942***	0.791***	1.270***	0.967***	0.496	1.204**
	(0.060)	(1.117)	(0.101)	(0.057)	(0.096)	(0.122)	(0.138)	(0.063)	(0.080)	(0.421)	(0.060)	(3.285)	(0.587)
Observations	15	18	20	19	17	20	23	20	20	17	21	14	16
Model chi-squared	0.095	1.444	0.564	1.862	2.204	3.900	4.433	3.228	4.010	1.645	19.878	0.383	1.527
Model significance, p-value	0.992	0.695	0.905	0.601	0.531	0.272	0.218	0.358	0.260	0.649	0.000	0.944	0.676
MICS													
OOP health expenditure as % of CHE	0.000	0.000	-0.001	0.000	0.000	-0.003	0.000	0.002	-0.003	-0.007*	0.001	0.032*	0.048*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.004)	(0.004)	(0.001)	(0.019)	(0.028)
Hospital beds per 1.000 people	-0.004	-0.003	-0.015*	-0.012***	0.008	0.057*	-0.021**	-0.001	-0.008	0.300*	0.018	1.889**	1.348**
	(0.004)	(0.005)	(0.008)	(0.004)	(0.013)	(0.030)	(0.009)	(0.012)	(0.035)	(0.162)	(0.014)	(0.741)	(0.611)
Average governance quality	0.010	0.022	0.025	0.000	0.065*	0.027	-0.027	0.096**	0.256	0.100	0.100***	0.978	2.023*
	(0.014)	(0.017)	(0.030)	(0.014)	(0.037)	(0.055)	(0.030)	(0.043)	(0.185)	(0.106)	(0.036)	(0.710)	(1.111)
Constant	0.962***	0.986***	1.011***	0.983***	0.931***	0.778***	0.784***	0.923***	1.228***	1.127***	0.883***	-1.201	-0.220
	(0.024)	(0.033)	(0.063)	(0.024)	(0.071)	(0.095)	(0.050)	(0.071)	(0.425)	(0.219)	(0.052)	(1.000)	(0.936)
Observations	42	47	48	50	45	46	52	47	49	45	45	36	36
Model chi-squared	1.233	2.281	4.128	11.573	4.441	10.926	8.880	5.237	2.189	4.568	9.908	6.654	5.445
Model significance, p-value	0.745	0.516	0.248	0.009	0.218	0.012	0.031	0.155	0.534	0.206	0.019	0.084	0.142
OECD													

OOP health expenditure as % of CHE	-0.001	0.000	0.000	0.000	-0.002*	-0.005*	-0.001	0.001	0.000	-0.006	0.001	0.013	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.003)	(0.009)	(0.001)	(0.028)	(0.007)
Hospital beds per 1.000 people	-0.005	-0.003	-0.006	-0.004*	-0.009*	0.006	-0.018*	0.001	-0.007	0.144	0.004	0.474	0.025
	(0.004)	(0.003)	(0.004)	(0.002)	(0.005)	(0.019)	(0.010)	(0.006)	(0.013)	(0.119)	(0.009)	(0.657)	(0.143)
Average governance quality	0.022**	0.011	0.024	0.005	0.038**	0.115**	0.037	0.060***	0.068	0.087	0.067***	0.800	0.638
	(0.010)	(0.009)	(0.015)	(0.008)	(0.015)	(0.049)	(0.033)	(0.019)	(0.052)	(0.128)	(0.025)	(1.583)	(0.463)
Constant	0.991***	0.966***	0.941***	0.955***	0.990***	1.032***	0.887***	0.927***	1.008***	1.365***	0.907***	0.252	1.101**
	(0.024)	(0.023)	(0.032)	(0.018)	(0.034)	(0.113)	(0.077)	(0.039)	(0.183)	(0.476)	(0.047)	(1.588)	(0.538)
Observations	48	50	53	52	47	50	55	47	49	38	51	15	17
Model chi-squared	9.671	2.867	3.258	3.331	14.587	13.517	4.848	12.974	2.008	2.469	10.582	0.683	2.406
Model significance, p-value	0.022	0.413	0.354	0.343	0.002	0.004	0.183	0.005	0.571	0.481	0.014	0.877	0.493

Source: Author's calculations.

Notes: Simar-Wilson models estimated with 1,000 bootstrap replications. Robust standard errors in parenthesis. *p<0.1, **p<0.5, **p<0.01.