Efficiency of public social expenditure in the Arab States

UNITED NATIONS
الاسكوا
ESCWA

Shared Prosperity Dignified Life

UNDP
Empowered lives.
Resilient nations.

unicef

Distr.
LIMITED
E/ESCWA/CL3.SEP/2021/3/TP.4
4 January 2022
ORIGINAL: ENGLISH

Economic and Social Commission for Western Asia

Social Expenditure Monitor Report background paper series

Efficiency of public social expenditure in the Arab States

United Nations
Beirut, 2022

Note: This document has been reproduced in the form in which it was received, without formal editing.

22-00007

Authors: Jan Gaska, Nathaniel Martin, Malak El Baba, Niranjan Sarangi.

United Nations publication issued by ESCWA, United Nations House, Riad El Solh Square,

P.O. Box: 11-8575, Beirut, Lebanon.

Website: www.unescwa.org.

Acknowledgement

The paper "Efficiency of Public Social Expenditure in the Arab States" is the result of background research to inform the Social Expenditure Monitor Report entitled: "Social Expenditure Monitor for Arab States: Toward making budgets more equitable, efficient and effective to achieve the SDGs".

The authors acknowledge research inputs from Nour Rmeih, Bilal Farhat, and Dana Hamdan; The background paper has been presented and discussed in the Social Expenditure Monitor Regional Expert Group Meeting (EGM), held in Amman, on 1-2 December 2021. The authors acknowledge the comments and suggestions from experts including N. Bhanumurthy, Zafiris Tzannatos, and other experts at the EGM; from UNDP Regional Hub in Amman including Vito Intini, Rania Uwaydah, Walid Merouani, Devika Iyar, and Fekadu Terefe; UNICEF MENARO including Samman Thapa and Juan Bester.

Contents

Abstract

The paper analyzes the efficiency of social expenditures in the Arab countries and their association with governance and other determinants. The paper applies a novel methodology to compute efficiency of social expenditures in five dimensions and 15 indicators of social expenditure monitor – education, healthcare, social protection, environment, and housing – using available cross-country data for 127 countries.

Results indicate that the efficiency of social expenditures in Arab countries is lower than the global as well as the benchmark average of high-income countries. Education, housing and environmental protection are identified as areas where Arab countries have significant inefficiencies that can be improved. Health expenditures register higher efficiency scores than education, however high out-of-pocket spending might explain the outcome indicators.

Furthermore, the analysis shows that the efficiency of social expenditures is driven mostly by the quality of governance (as reflected in the World Governance Indicators) and the link between efficiency and level of expenditures or size of the fiscal space (as reflected by government balance) is relatively weak. It concludes that improving efficiency of public social expenditure will facilitate gains in development outcomes without the need to commit additional fiscal resources and proposes that Governments can save resources by improving efficiency of spending, which can be channeled to finance other development priorities.

1. Introduction

A better assessment of productive efficiency of social expenditure is an important aspect for policy makers to improve allocations to the neediest sectors and populations. Previous cross-country experiences of social policies are mixed, especially considering impact of social expenditures with or without general subsidies, social expenditures with cash or in-kind transfers vs. other kinds of public interventions supporting skill development, social insurance among others.[1] Recent analyses suggest that governance does play a role in improving efficiency of social expenditures, but so too the choice of public policy and its targeting to specific populations.[2]

Arab countries, when compared to countries with similar income levels, lag on socioeconomic outcomes more than they do on social expenditure, which signals the need to improve the efficiency of social expenditure.[3] Through this paper we aim to broaden the list of assessment of efficiency of public social expenditure in relation to their performance and identify the areas of efficiency gaps. We also aim to decompose efficiency by different components or indicators to contribute more specific recommendations, including shifts between different categories of expenditures showing the areas of inefficiency etc. Consequently, we can show which areas should be prioritized to achieve most improvement.

In addition, we correlate these efficiency scores with a list of variables that are identified in the literature as drivers of efficiency. Our results are more in line with previous studies, but they provide more in-depth assessment for a broader set of indicators.

A value addition of our paper is the simulation of the efficiency scores for specific policy, which enables policy makers to assess the benefits of improving efficiency to benchmark levels. It answers to the question: What would be the output level if efficiency levels increased to benchmark level, given the same level of expenditure? Alternatively, it informs policy makers to assess cost savings by identifying areas to improve efficiency with the same output levels. These simulations are demonstrated for two selected countries.

The paper is organized as follows. Section 2 presents different measures of social expenditure. Section 3 explores trends in public social expenditure and socio-economic outcomes. Sections 4 and 5 present the methodology for measuring efficiency and the efficiency scores for the Arab region, respectively. Policy simulations for Jordan and Tunisia are explained in section 6. Section 7 concludes.

2. Measuring Public Social Expenditure

In the literature there are several definitions and measures of social expenditures. The narrowest one treats social expenditures as equal to the *social protection* spending. IMF (2019, 2020) defines

[1] IMF 2020 (social expenditure and inclusive growth); The World Bank 2021 (HCI); ESCWA 2017 (Rethinking Fiscal Policy Report).
[2] Rajkumar and Swaroop 2008 ; Sarangi and von Bonin 2017; Mohanty and Bhanumurthy 2018.
[3] IMF 2020.

social expenditures as education and health spending in addition to the basic social protection outlays. Particular emphasis should be put on the *basic* education and health services, such as primary and secondary education and basic health services.

According to OECD (2019), *social expenditure is the provision by public and private institutions of benefits to, and financial contributions targeted at, households and individuals in order to provide support during circumstances which adversely affect their welfare, provided that the provision of the benefits and financial contributions constitutes neither a direct payment for a particular good or service nor an individual contract or transfer.* Consequently, transfers between households, remuneration for work or services, or benefits provided by the employer to employees are not treated as social expenditures. Therefore, the expenditure to be classified as social needs to address social purposes and programmes regulating the provision should involve either compulsory participation or interpersonal redistribution. Consequently, the OECD definition does not include R&D expenditures, administrative costs or education. On the other hand, private social expenditures are also included as well as capital transfers on accrual basis.

Also, as the provision of health and education is sometimes additionally financed by private expenditures, some authors argue that they should be also counted as input. Especially in case of countries where such outlays constitute significant share of total health and education spending, such as the United States. This may significantly alter efficiency scores (Kirkegaard, 2015). On the other hand, it must be kept in mind that systems where health and education services are financed privately significantly affect the equality of opportunities. As investment in human capital exhibits significant rates of return (see Psacharopoulos & Patrinos (2018) for the review), financing these sectors from private sources exacerbate income inequalities. Similar conclusion is drawn at the aggregate level by Caminada & Goudswaard (2005). Furthermore, private social protection expenditures, understood as the transfer from wealthier households to less privileged ones, can contribute to decrease in poverty and income inequalities. This may be especially valid in countries in which *zakat* contributions are important. Nevertheless, as IMF (2020) argue, these contributions are relatively small in comparison to other categories of social spending. The only exception is Saudi Arabia, where these contributions are mandatory and channelled through the state budget, so they are included in public social expenditures.

Some institutions recently pursued wider approach to social expenditures, labelling such areas as environmental protection, culture and labour market policies as social outlays. This approach was adopted, for example, by OECD, which includes housing expenditures, unemployment benefits and expenditures on active labour market policies in its social expenditures database. Furthermore, according to their definition, social expenditures *comprises cash benefits, direct in-kind provision of goods and services, and tax breaks with social purposes*. Therefore, even though unemployment or housing as well as active labour market policies are taken into account, education and health expenditures are not considered in this definition. Their approach is based on the unconditionality of the support – therefore, the beneficiary household is not required to take any particular action in exchange for the benefits.

ECLAC (2016) defines social expenditures as the outlays related to one of six functions: environmental protection, housing and community amenities, health, recreation, culture and religion, education and social protection. In contrary to the OECD (2019), the approach of ECLAC (2016) does not concentrate on the unconditionality or the form of the benefit, but rather on the purpose of the expenditure. Therefore, it is based on economic function rather than on the way funds are spent.

Most governments report public expenditures according to the functional classification of expenditures (COFOG). However, these are reported at aggregate level at three-digit levels. The information allows the identification of social expenditure only in three areas: *education*, *health*, and *social protection*, such as proposed by the IMF. Social expenditure cannot be identified in other functional classifications as the expenditures are not adequately disaggregated between social and economic purposes. It is primarily the reason for which the IMF uses these three categories to assess social expenditure.[4] However, this leaves out several other expenditure aspects that contribute to the achievements of the SDGs.

To better understand social expenditure, in alignment with the SDGs approach, ESCWA developed a framework for measuring social expenditure by disaggregating the COFOGs or budget lines across all the areas of public expenditure. According to ESCWA (2019), *social expenditures are considered strategic, long-term social investments that enhance human capital and innovation, promote gender equality and improve inclusive growth* and defines 7 dimensions of social expenditures:

- Education;
- Health and nutrition;
- Housing and community amenities;
- Labour market interventions and employment generation;
- Social protection, subsidies and support to farms;
- Arts, culture and sports;
- Environmental protection.

Each dimension comprises several categories that conform to the expenditure's development purpose and map to main beneficiaries across individuals, households, and communities. The dimensions cover all public expenditures that have a social purpose aligned with targets in which the 2030 Agenda aims for improvement or universal access (covering about 47 out of the 169 targets). The seven dimensions aim to capture crucial social development priorities in the Arab region and represents a concrete step towards aligning thinking on social policy interventions and fiscal space with national budgets and macroeconomic policy (E/ESCWA/EC.6/2019/8/Rev.1).

[4] Other functional expenditures include expenditure on Defense, Economic Affairs, Environmental protection; General public services; Housing and community amenities; Public order and safety, and Recreation, culture, and religion.

3. Trends in Public Social Expenditure and Socio-Economic Outcomes

3.1 Social Expenditures in Arab Countries vs Outcome

The region's achievements in key outcome indicators vs. that of the World are discussed below across various categories of social services that are used for efficiency assessment. It is to be acknowledged that the role of social expenditure is crucial to influence achievement in outcomes, however it is not the sole factor. Quality of governance, access to technology, targeting to the needy and most vulnerable, equity in allocation of expenditures and level of development of a country have critical impacts on achieving outcomes as well. However, public social expenditure, including targeting to social services areas, is a significant determinant of achieving human development outcomes.[5]

As expected, the association between public social expenditure and inequality-adjusted human development index scores has a strong positive correlation (figure 1). Progress of human development is strongly associated with increasing public social expenditure to targeted sectors such as education and health.[6] In the region, the rate of increase in the human development index (HDI) has slowed down markedly since the 1990s. The slowdown is partly because incremental advancement of HDI is harder, but also in large part the budget share going to health and education has remained almost stagnant, or declined in recent period.

The correlation of social expenditure with education outcomes globally is positive which indicates that, on average, countries with a higher public expenditure in education are associated with higher education achievements. In our sample of Arab countries, the correlations between public education expenditure and expected years of schooling are somewhat ambiguous. While there is strong positive association between education achievements and public expenditure in education in low-income countries, some middle- and high-income countries have progressed on achieving education outcomes despite stagnating public expenditures in this sector. These counterintuitive results can partially be explained by the relatively low importance of public against private education investment in these countries. Cross-country data on private finance in education are lacking, but a look at the percentage of enrolment in primary education in private institutions gives us an approximation of the importance of the private finance. For instance, enrollment in private schools in some countries such as the United Arab Emirates, Lebanon, and Qatar, particularly at primary level, reaches over 50 percent[7]. Therefore, there has been substantial differences in the effects of public social expenditure on education among different groups of countries. The positive effect of increasing education expenditure has been highest in the group of resource poor countries than that of the group of resource rich countries.[8] Furthermore, global evidence suggests that higher quantity of education does not automatically lead to better quality. Patel and Sandefur (2020) show, after controlling for income per capita, the correlation between average years of

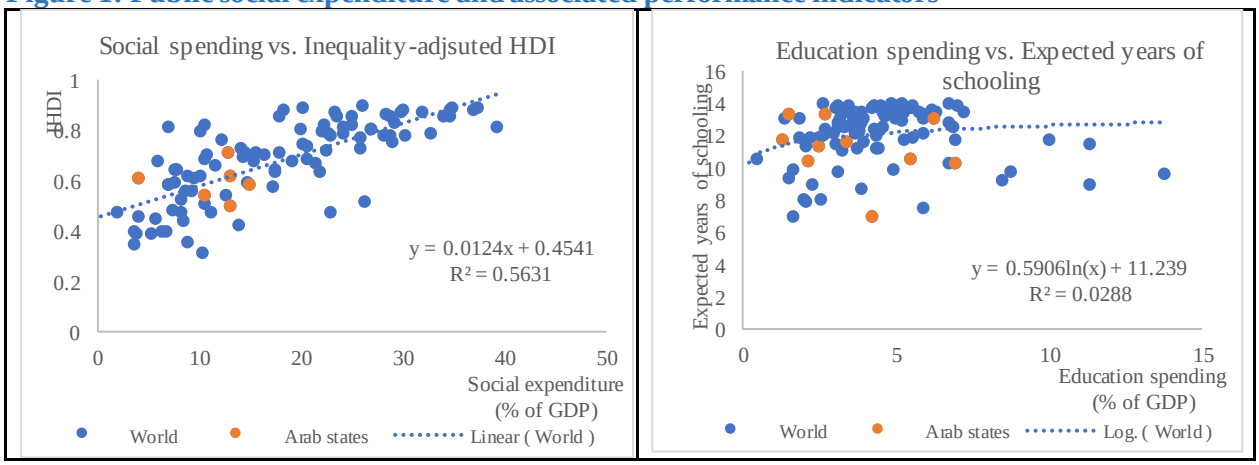
[5] IMF 2020; ESCWA 2017; Sarangi and von Bonin 2017.
[6] Sarangi and von Bonin 2017.
[7] UNESCO (2020). 'School enrolment, primary, private'.
[8] Sarangi and von Bonin 2017.

schooling and conventional measures of educational quality remains weak (0.32). Importantly, the correlation between public education spending and educational quality is stronger at lower levels of funding and in developing countries (figure 1).

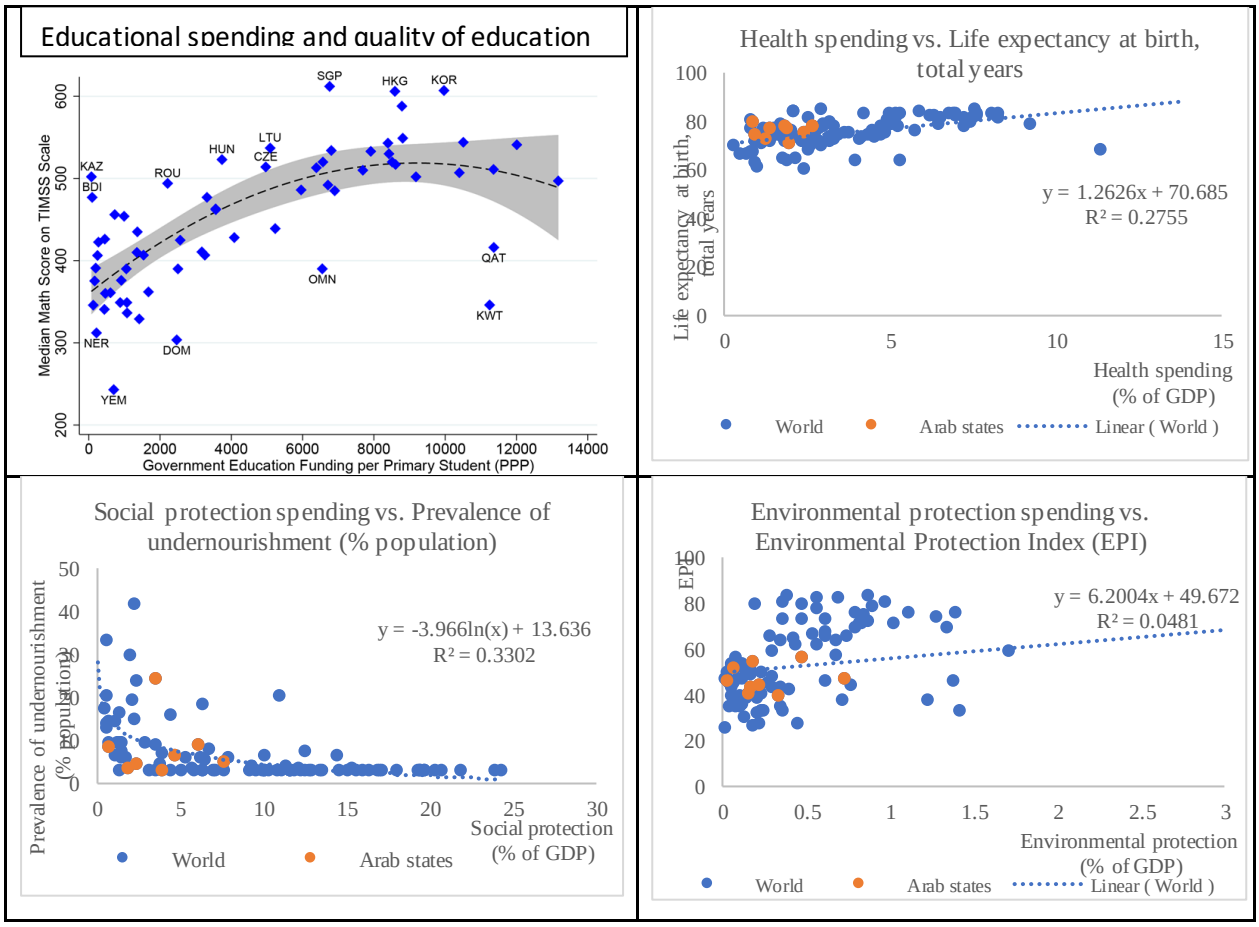
Similarly, the correlations of life expectancy and public health spending show a positive association both in our sample of Arab countries and in the worldwide sample. The overall positive correlation shows on average that countries with a higher public expenditure in health are associated with a higher life expectancy. However, the positive correlation in our sample of Arab countries is less pronounced than in the global sample. One reason for this weaker association can be found in the explanation of the health systems in Arab countries. One of the characteristics is an unusually high share of out-of-pocket (OOP) expenditure in total health expenditure where private households are carrying a high financial burden. An average of 27 percent of total health expenditure (THE) in the Arab region is through OOP payments, this compares poorly against the world average of 18 percent[9]. Within the region, the share of OOPS in health finance is associated with the country's income status, where some of the poorest Arab countries have the highest rates of OOPs in health. Thus, private expenditures explain the relative advancement in health outcomes despite low public expenditure in health.

Social protection expenditure shows a strong pattern with declining undernourishment. The environment protection index shows a positive association with expenditure on environment protection albeit the correlation is not strong enough.

Figure 1: Public social expenditure and associated performance indicators



[9] World Bank (2021) World Development Indicators. 'OOP as a proportion of GHE'.



Source: Gaska et al 2021.

Given the association of expenditure and their performance in outcomes, using the global sample of countries, it would be useful to examine the level of achievement in outcomes in the region, and country groups, against the global average in relation to assessing efficiency.

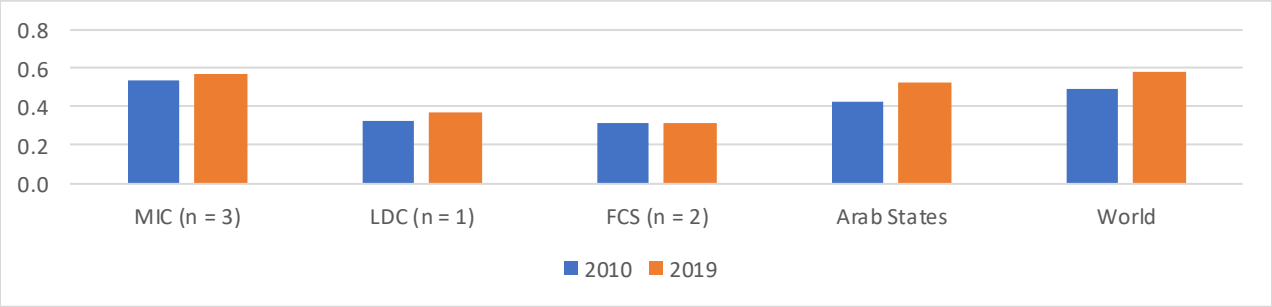
Outcome of overall social expenditure: Inequality-adjusted human development index score

Broadly, the Arab countries have achieved substantial improvements in several key indicators over the last decade, but the region still falls behind world averages in most measures of human development. Inequality-adjusted Human Development Index (IHDI) is used as a measure of overall success, as it measures a country's achievements in education, health, and income as well as how evenly those achievements are distributed among the population. The use of IHDI provides insights not only on the level of development of countries, but also reflects the level of inequality each country is facing. As such, the IHDI contributes to designing efficient policies targeted at reducing inequalities in different development areas, such as education and health.

The Arab Region's IHDI was significantly below the world averages in both 2010 and 2019, indicating significant development challenges in the region. However, this comparison between

Arab and world averages is not necessarily representative, as none of the six Arab HICs received an IHDI score in 2010, and only Oman received an IHDI score in 2019. Because GDP per capita is a major component of IHDI, Arab HICs would likely achieve high scores, and their inclusion would raise the regional average. The MIC and LDC countries achieved gains in IHDI from 2010 to 2019, with Tunisia, Mauritania, and Jordan making the greatest numerical improvements. IHDI declined for Yemen, for the lone FCS country in the available data. To ensure reliable comparisons and avoid the influence of changing country composition, Figure 2 only includes MIC, LDC, and FSC countries with IHDI scores for both 2010 and 2019. Values for the Arab States and World are published averages.

Figure 2: Inequality-adjusted Human Development Index

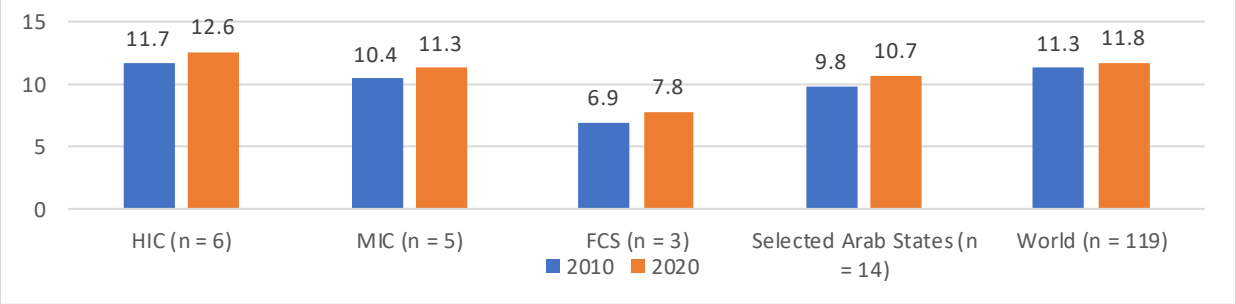


Source: United Nations Development Programme Human Development Reports; own calculations

Outcomes of education expenditure: Schooling years, teacher-pupil ratio, test scores

In education, Arab states have generally made progress in increasing the number of expected years of schooling and reducing pupil-teacher ratios, but the region has failed to produce better performances on international standardized exams. The regional average for expected years of schooling was 10.7 years in 2019 for countries with available data, which was lower than the global average of 11.8, as displayed in Figure 3. However, the data suggest that Arab states are "catching up" with the rest of the world by improving at a faster rate. Egypt, Iraq, Saudi Arabia, Palestine, and the UAE all achieved improvements of more than 1 year of schooling over the decade. Jordan, Kuwait, and Qatar were the three Arab states which saw the indicator decline from its 2010 value. While Lebanon, Sudan, and Comoros did not have available data for the indicator in 2010, these countries also experienced a reduction in expected years of schooling from 2016 to 2020.

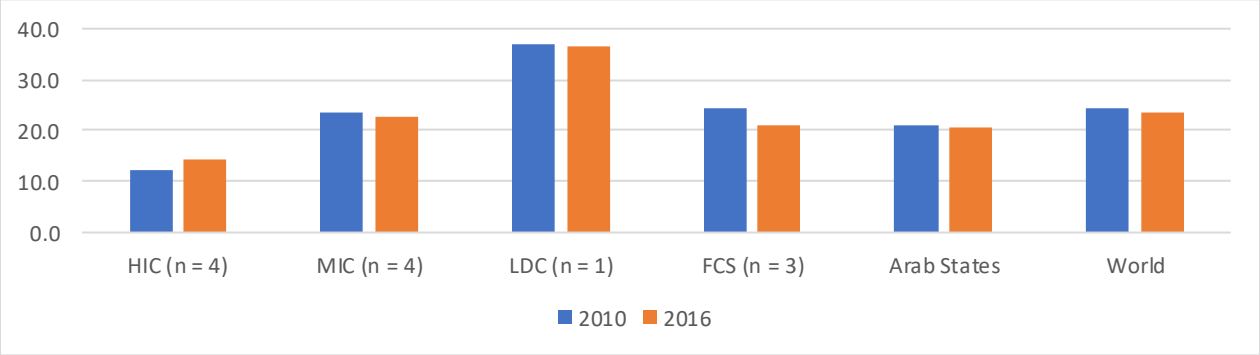
Figure 3: Expected years of schooling



Source: World Bank World Development Indicators; own calculations

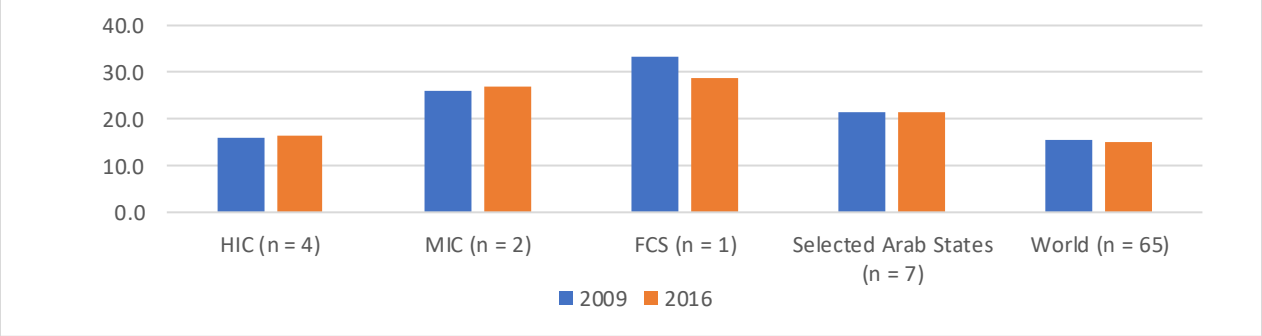
Low pupil to teacher ratios indicate better outcomes as students can receive more individualized instruction from their teachers. In both 2010 and 2016, HIC countries recorded the fewest students per teacher in the region, but they were the only group to not demonstrate improvement between the two years at both the primary (Figure 4) and tertiary levels (Figure 5). Notably, the UAE's primary pupil-teacher ratio increased significantly from 16 in 2010 to 25 in 2016. MICs improved their primary pupil-teacher ratio. The tertiary ratio increased for MICs, but this was solely due to Morocco's pupil-teacher ratio increasing from 21 to 29 and not necessarily indicative of a broader trend. The four LDCs and FCSs with available data for these indicators saw improvements in both ratios from 2010 to 2016. These are Mauritania, Yemen, Lebanon, and Palestine.

Figure 4: Primary pupil-teacher ratio



Source: World Bank World Development Indicators; own calculations

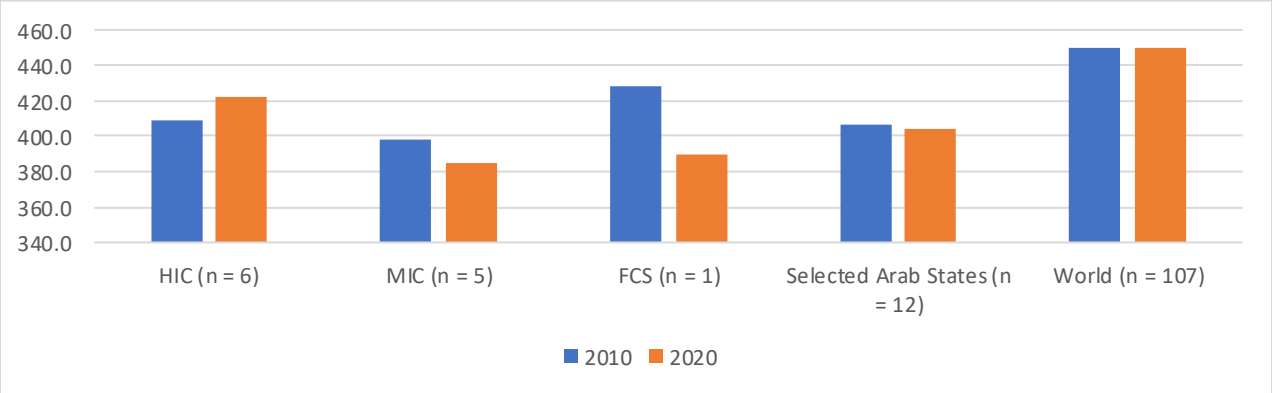
Figure 5: Tertiary pupil-teacher ratio



Source: World Bank World Development Indicators; own calculations

Despite progress in other education-related indicators, Arab countries failed to demonstrate a material improvement in harmonized test scores. The harmonized test score indicator, presented in Figure 6, is computed from scores on various international student achievement tests, which are converted to a scale ranging from 325 to 650. Seven Arab countries saw an increase in their harmonized test scores from 2010 to 2020, while six Arab states saw a decrease. Notably, Egypt, Algeria, and Tunisia all saw performances fall in the tests used to compute the 2020 indicator, as evidenced by the substantial decline in the chart for MIC countries. With a value of 452, Bahrain was the only Arab country to exceed the world average in 2020, but since this indicator covers only 107 countries and omits many LDCs, it is not a representative average.

Figure 6: Harmonized Test Scores



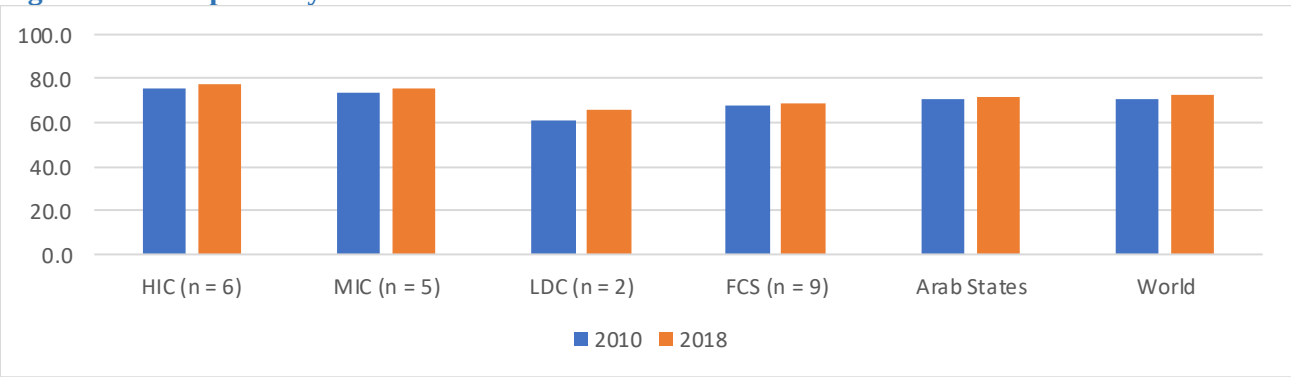
Source: World Bank World Development Indicators; own calculations

Outcomes of health expenditure: Life expectancy, infant mortality, maternal mortality

Health outcomes have improved across the Arab Region during the last decade. From 2010 to 2019, the Arab States raised their average life expectancy from 70.3 years to 71.8 years, while world life expectancy increased from 70.6 years to 72.6 years, as seen in Figure 7. High-income HIC countries tend to have the highest life expectancies, led by Qatar, the only Arab state with a life expectancy greater than 80 years. On the other end are the LDCs, which have an average life expectancy of 63.5 years. Of the 22 Member States, only Syria experienced a decline in life expectancy from 2010 to 2019. The greatest improvements were in

least-developed countries such as Djibouti, where life expectancy increased by 6.5 years, and Somalia, where the indicator rose by 3.1 years. Morocco stands out as the sole MIC country to achieve a life expectancy gain greater than 2 years.

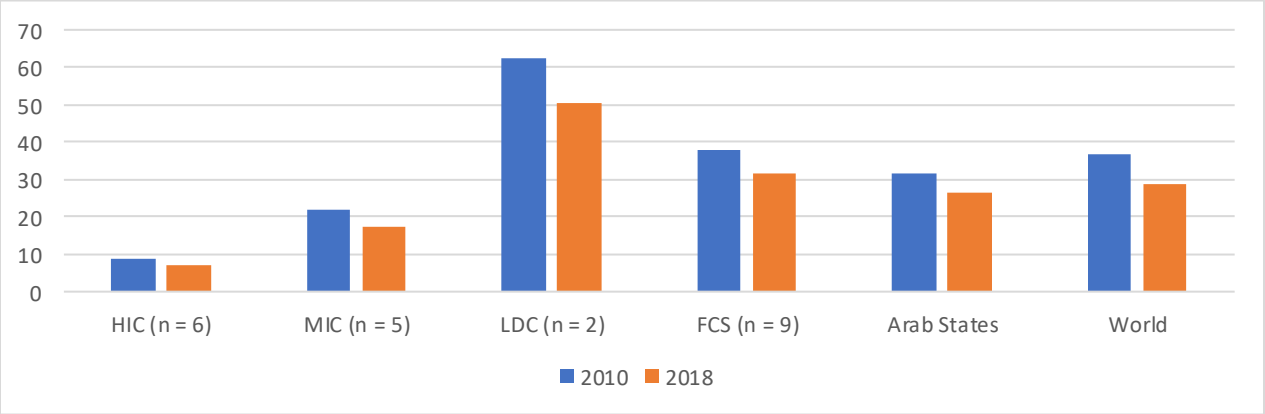
Figure 7: Life expectancy



Source: World Bank World Development Indicators; own calculations

Health outcomes improved region-wide for infants and children, as all subregions achieved both a reduction in their infant mortality rate and an increase in the probability of survival to age 5. Arab states achieved better outcomes than world averages for both these indicators (Figure 8). However, there are substantial differences across subregions with least-developed countries achieving far worse outcomes than the other groups. The infant mortality rate for the LDCs fell from 62 deaths per 1,000 live births in 2010 to 51 in 2018. The FCS group was next, followed by the MICs. The HIC countries performed best with 7 deaths per 1,000 live births.

Figure 8: Mortality rate, infant per 1,000 live births

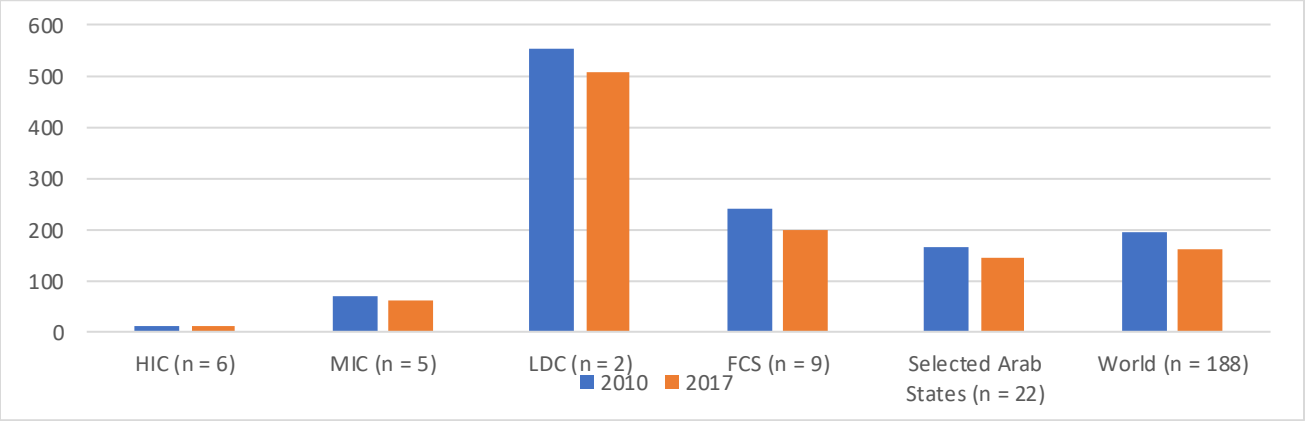


Source: World Bank World Development Indicators; own calculations

The maternal mortality ratio exhibited a similar pattern, where maternal deaths in least-developed countries vastly exceed those in the other subregions (Figure 9). The LDCs recorded 507 deaths per 100,000 live births, roughly 2.5 times that of the next closest group, the FCSs. When

aggregated, all four subregions recorded improvements in the indicator, but there were setbacks in a few countries. Specifically, the maternal mortality rate increased from 70 to 79 in Iraq, from 23 to 29 in Lebanon, and from 53 to 72 in Libya.

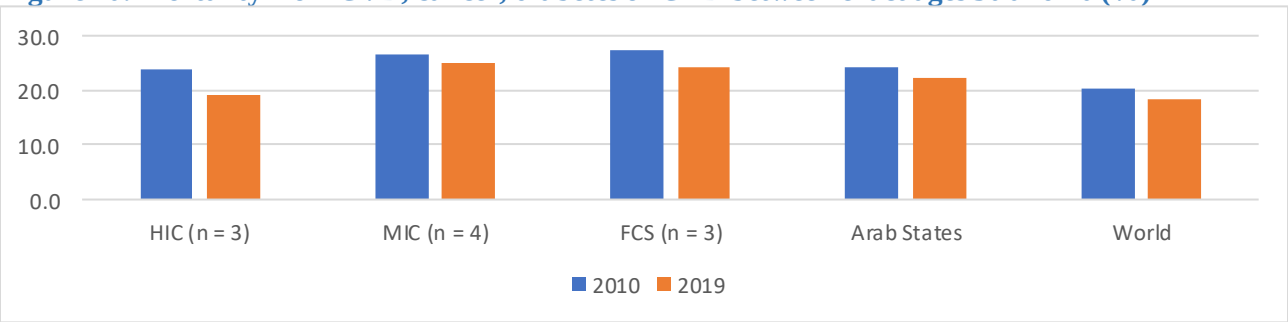
Figure 9: Maternal Mortality Ratio



Source: World Bank World Development Indicators; own calculations

The Arab Region's mortality rate from cardiovascular disease, cancer, diabetes, or chronic respiratory disease decreased substantially over the last decade but remains elevated compared to the rest of the world (Figure 10). 19 of the 22 countries achieved improvements in this indicator, with the exceptions being Libya, Syria, and Yemen, all conflicted-affected countries. Of the available subregions, HIC countries observed the greatest reduction in mortality since 2010, as the rate declined by 5 percentage points from 24 to 19.

Figure 10: Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 (%)



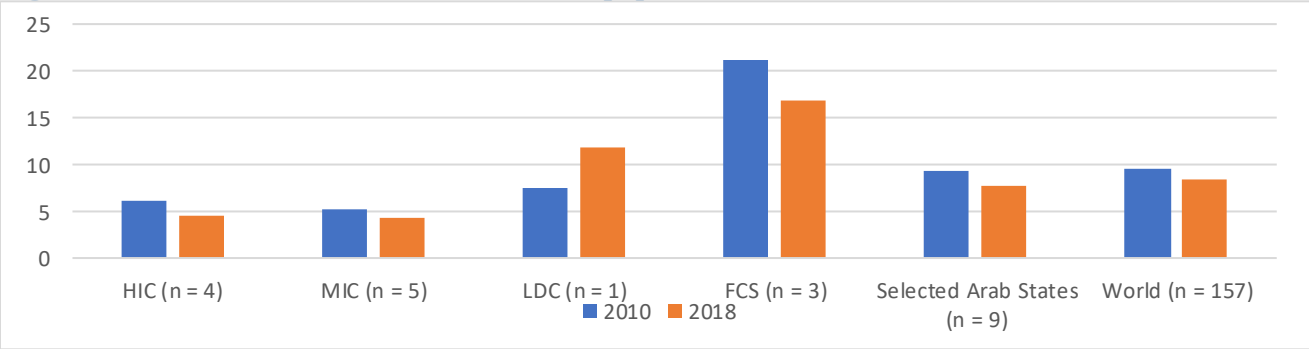
Source: World Bank World Development Indicators; own calculations

Outcome indicators of social protection expenditure: Undernourishment, disability and pension coverage

Collectively, Arab states were on par with the rest of the world in the prevalence of undernourishment in both 2010 and 2018 (Figure 11). The indicator declined during the last decade

for all Arab states with sufficient data except Iraq and Mauritania. Undernourishment rates are now below 5% for the HIC and MIC countries. The FCS group made improvements in reducing undernourishment thanks to Sudan, which nearly halved its undernourishment rate from 22 per cent to 12 per cent. Concerningly, undernourishment increased from 7 per cent to 11 per cent in Mauritania, the lone LDC in the sample. Iraq possessed the highest prevalence of undernourishment in the region at 24 per cent, according to the latest available data from 2018.

Figure 11: Prevalence of undernourishment, % population



Source: World Bank World Development Indicators; own calculations

Other indicators for the social expenditure category lacked sufficient data to analyze progress over time, so we present charts based on the most recent available data. The proportion of the population with a disability (Figure 12) is very low in the Arab region, likely due to under-diagnosis and under-reporting. Statutory pension rates for persons of pensionable age are also low (Figure 13). The average pension rate for the Arab countries was 37%, compared with 71% for the world average. However, the world average is unrepresentative because it includes only 62 countries with available data, which tend to be more developed countries.

Figure 12: Proportion of population with severe disability

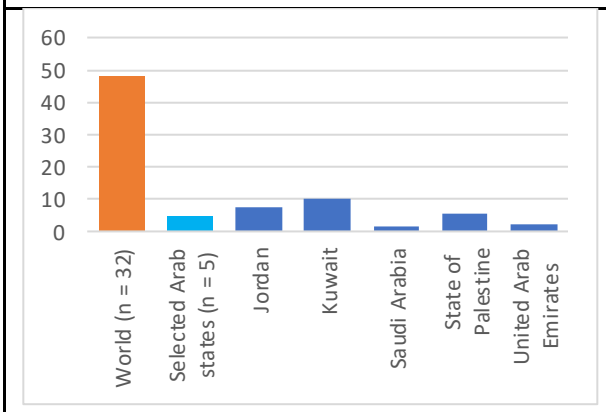
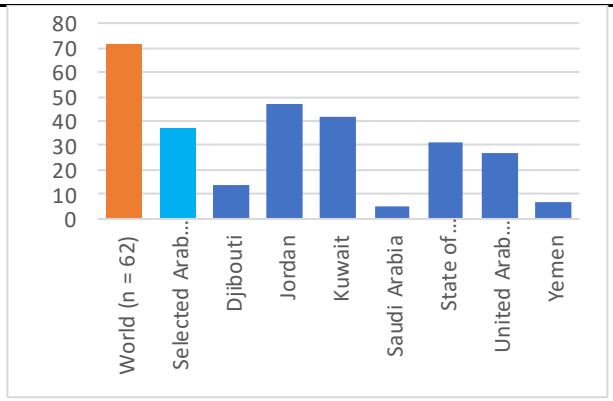


Figure 13: Proportion of population above statutory pensionable age receiving a pension (%)

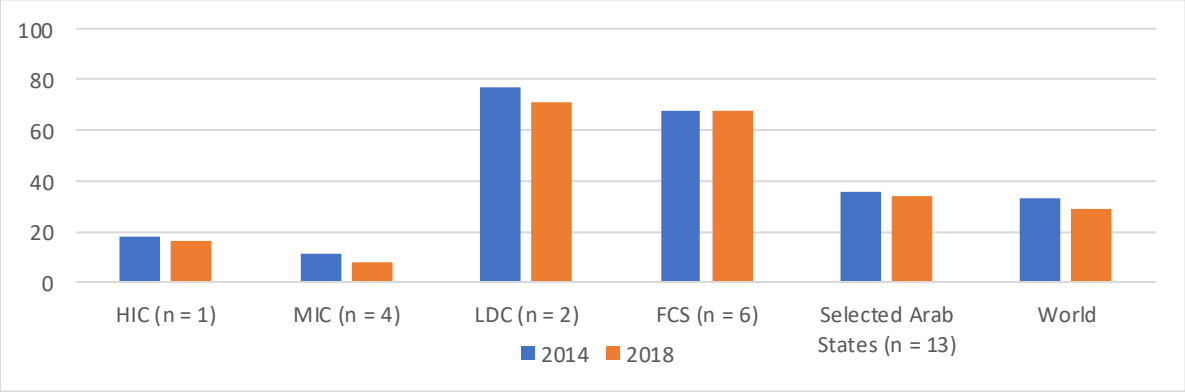


Source: World Bank World Development Indicators; own calculations

Outcomes of housing expenditure: Urban slum population

From 2014 to 2018, most Arab states reduced the proportion of their urban population living in slums, indicating better housing and community amenities (Figure 14). Middle-income countries had the lowest proportions of their urban population living in slums. In the most recent data, the rate was less than 10% in each of Tunisia, Egypt, and Morocco. Rates over 50% were observed for Lebanon, Somalia, and Yemen. Six Arab states had data for the indicator but were left out of the aggregations as information on the size of the urban population was unavailable. Of these countries, Sudan had the most elevated rate in the region at 88 per cent, down from 92 per cent in 2014. Syria notably saw its rate double from 19% to 38% in a span of four years.

Figure 14: Population Living in Slums % of Urban Population



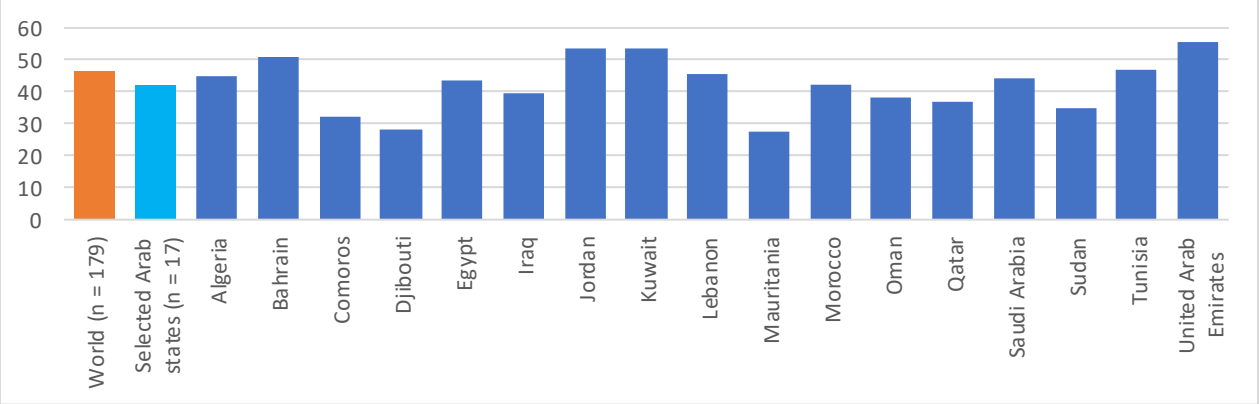
Source: World Bank World Development Indicators; own calculations
Note: Data was available for 13 Arab states. To calculate aggregations for the region and income groups, information on the size of the urban population was needed. This was only available for 8 countries. To show the

most countries possible in the chart, we used total population as a proxy for urban population and weighted by that metric. Total population had a correlation of 0.95 with urban population in the countries with both figures available.

Outcomes of environment protection expenditure: Environment performance index

Environmental Performance Index (EPI) serves as a measure of overall achievements in sustainability, as it is based on a series of 32 indicators covering a variety of environment-related issues. Globally, EPI ranged from a maximum value of 82.5 for Denmark to a minimum value of 22.6 for Liberia. The average EPI for the Arab Region was 42.2, slightly below the world average of 43.6 (Figure 15). The best-performing Arab States were mainly HIC countries such as the UAE, Kuwait, and Bahrain, which all recorded EPI scores over 50. However, other HIC countries such as Oman and Qatar received considerably lower scores. Middle-income countries generally performed close to the regional average, except for Jordan, which was one of the highest achievers in the region. The lowest EPI scores in the Arab Region all came from least-developed countries, including Comoros, Djibouti, Mauritania, and Sudan.

Figure 15: Environmental Performance Index (2018)



Source: Yale Center for Environmental Law and Policy; own calculations

4. Assessing Efficiency of Public Social Expenditure: Methodology

4.1 Definition of indicators

Out of the seven dimensions of social expenditure, as defined by the SEM, this paper focuses on selected indicators for efficiency analysis, depending upon availability of comparable data. Specifically, this paper focuses on selected indicators pertaining to education, health, social protection and environmental protection. The reason for that is the unavailability of a single, robust and covering large number of countries indicator for housing and arts, culture and sports. In case of labour market expenditures and employment generation, outcomes can be easily misled with preconditions – i.e. if situation on the labour market is poor, then countries need to spend more money to fix this. To mitigate the risks of endogeneity, it is advisable to assess the efficiency of such expenditures using micro-level data e.g. on participants of labour market support programmes.

Another important distinction that needs to be considered is the type of indicators used for the efficiency evaluation. The five categories commonly described in the literature are as follows (EC, 2018):

1. **Input indicators** measure the financial, human, material, administrative and regulatory resources needed to implement a policy/programme. In case of social expenditures, these would be measures of outlays as a percentage of GDP or in monetary units;
2. **Process indicators** that reflect the activities that turn inputs into outputs. This can be such measures as the number of legal acts introduced, number of trainings conducted etc.
3. **Output indicators** that show the immediate and concrete consequences of the resources used and measures taken. In case of education this would be e.g. number of schools built, number of teachers trained etc., in case of healthcare e.g. number of hospital beds or doctors/nurses trained and for social protection programmes number of beneficiaries is commonly used.
4. **Outcome indicators** measure the direct effects on beneficiaries. The examples are school enrolment or pupil to teacher ratio for education, number of doctors *per capita* or access to healthcare indices for health sector and benefit coverage for social protection.
5. **Impact indicators** reflect the progress towards overall policy objectives – ultimate results of the given project or policy. The examples are literacy rate or average test scores for education sector, changes to life expectancy or mortality rates for healthcare and such indices as poverty rate, Gini or food insecurity for intervention in the area of social protection.

Ideally, in the efficiency analyses, the impact against the input indicators should be used. That would allow for measurement of the efficiency along the whole *production* chain of social services. Furthermore, while comparing the efficiency between different areas, the same category of indicator should be used. In this study, we will assess the efficiency based on impact indicators, whenever possible.

4.2 Impact of Selected Indicators on Outcomes: A Review

The link between improvements in health indicators such as life expectancy, child and infant mortality and maternal mortality rates and expenditures on health is relatively well documented in the literature. Linden & Ray (2017) analyse the relationship between public and private health expenditures and life expectancy in the OECD countries and conclude that both streams of funds positively affect life expectancy. Furthermore, they argue that higher public expenditures boost private outlays (except for the US). However, in their study, the relationship is non-linear – the linkage between health spending and life expectancy is stronger in countries with more significant share of health expenditures in GDP, suggesting that improvements in life expectancy are secondary to other policy goals in the area of health (e.g. reduction in infant or maternal mortality). Novignon et al. (2012) using panel data from 44 countries in sub-Saharan Africa concludes that health expenditures have significant impact on crude death rate, infant mortality rate and life expectancy at birth. Furthermore, he shows that when private and public outlays are considered,

the latter are more efficient in shaping outcomes, which is in line with economic theory. Van Baal et al. (2013) discuss methodological problems associated with estimation of the interlinkage between different health quality indicators and provide overview of studies aiming at assessing the link between health expenditures and life expectancy. They show that variation is existing estimates is huge, depending on methodology and data used. Furthermore, reverse causality issue (higher life expectancy means that they are more older people, who often require significant healthcare expenditures) is rarely addressed in the literature. Heijink et al. (2012) analyse the lagged effects of healthcare expenditures based on data from high income economies and conclude that lagged health expenditures also affect life expectancy, though this effect fades out over time.

Similar results were found for education expenditures. As Glewwe et al. (2011) point out, the threefold increase in education expenditures in Middle East, doubling in Sub-Saharan Africa and even greater boost in Asia between 1980 and 2008 led to huge increases in primary and secondary education enrolment, such that for the primary education it is close to 100% or greater in almost all countries in the world. While school enrolment is clearly linked to surge in education outlays, there is less evidence on their impact on quality indicators such as PISA/TIMMS score While it may be argued that higher enrolment rates bring to schools less talented students affecting the average test score, there are some countries in which the enrolment was steady over the period, education expenditures rose and test results did not change much. In seminal article, Hanushek (2003) summarizes the evidence on the link between education expenditures and education outcomes showing that there is no evidence on the direct relationship between test scores and inputs. This finding holds regardless of whether regional US data over time or international comparisons are used. In addition to that, different measures of inputs were used such as pupil-teacher ratio or teacher salary and no compelling results on the impact on test scores were found. Hanushek (2003) argues that teacher quality matters and huge variation in teacher quality is observed, what makes policy design even more difficult, as the teacher *quality* measured by outcomes of her students is barely correlated with such traits as education or test scores. He proposes to pursue incentive-based policies such as linking teachers' salaries to the outcomes of their students or performance contracting. Designing such policies is, however, very difficult especially if there is no history of evaluations that would provide *baseline* performance. Nevertheless, the availability of data and methodological advances pave the way for better identification techniques should enrich our knowledge on the efficient educational policies (Hanushek & Woessmann, 2016).

The third broad category that is often included in the social expenditure category are social protection outlays. As in this case, the link between benefits and outcomes is more direct (there is no issue of the quality of doctors, access to medicines or teachers), the relationship between poverty reduction and inputs should be more evident. This is indeed the case – Fiszbein et al. (2014) show that social protection programmes lift 150 million people out of poverty across developing world. Furthermore, they analyse how efficiently these programmes are targeted and decompose their total effects into the results of expenditures and the effects of proper targeting. They conclude that even in best-performers only about 40-50% of total social protection

expenditures reach the people below the poverty line. Gouswaard & Caminada (2010) shows that social protection systems reduce the Gini coefficient by 8 to 46 percent. On the basis of cross-country data, they found positive relationship between the social protection expenditures and income redistribution with the strongest effect of public programme targeted towards the old-age. In their later paper, they show strong negative relationship between poverty and social expenditures in the OECD between 2003-2007 (Gouswaard & Caminada, 2012). In very recent paper, Cammeraat (2020) use the data from the EU countries to demonstrate that public social protection expenditures do reduce both poverty and inequality, but the strength of relationship depends on type of outlays – in line with theoretical observation that targeted intervention should be more efficient. Cammeraat (2020) shows that the strongest impact of inequalities and poverty is observed in case of family benefits, while unemployment and housing-related expenditures are efficient way of reducing poverty, but not inequality. The weakest link between impact indicators and inputs was found in case of "old-age and survivors", where no statically significant relationship was found. Given these differences, treating various categories of social protection expenditures differently is essential for obtaining meaningful results.

There are also a lot of studies linking the state of environment to either public expenditures in general or to the public expenditures on environmental protection. For example, Lopez et al. (2011) argues that government expenditures on *public goods* (so on education, healthcare, environmental protection) tend to decrease pollution levels, while the outlays on *private goods* (such as subsidies, transfers etc.) act in the opposite direction. They measure the SO_2 levels as a proxy of air pollution and biological oxygen demand (BOD) as a proxy of water pollution and prove these hypotheses empirically. Therefore, social expenditures as such can lead to improvement in the state of environment. There are less studies on the impact of environmental-related outlays on the state of environment – possibly due to the endogeneity issues (worse environment requires higher expenditures) or heterogeneity and difficulties in measuring outputs (as the environmental policy should aim at reduction of pollution, increase in biodiversity, CO_2 emission mitigation etc. and it would be difficult to include all these dimension in single indicator). However, Gholipour & Farzanegan (2017) assess the relationship of environmental spending in MENA countries and air pollution levels and conclude that the strength of this linkage is dependent on quality of governance, which is consistent with theory and earlier studies. In addition to that, there are some studies aiming at the assessment of environmental expenditures at the lower (subsector) level. For instance, Arimura et al. (2012) calculate the effectiveness of demand-side management energy efficiency programs and conclude that each kWh of saved energy costs funders around 5 cents, Balana et al. (2011) summarize cost effectiveness studies aimed at assessment of intervention in water sector and Roth & Jaramillo (2017) evaluates the effectiveness of preserving existing nuclear power plants and conclude that this is effective option of achieving significant CO_2 emission reduction. These studies highlight significant problems that are faced by researchers who aim at the assessment of the link between environment and public policy – the quality of environment is difficult to measure and dependent on initial state that is independent on the actions of government. In addition, the link between the level of economic development and environment is U-shaped –

the term Environmental Kuznets Curve is deeply rooted in the literature (see Stern (2017) for the review) and this may affect how much government spends on environmental issues. Consequently, the measurement of the efficiency of environmental expenditures is very challenging task.

There is also quite a lot of evidence on the linkage between social expenditures and outcomes in general setting where outcome indicator is some measure of social development. For instance, Rajkumar & Swaroop (2008) show that low level of corruption and good governance quality are crucial determinants of the efficiency of social expenditures, especially in case of health and education. Haile & Nino-Zarazua (2018) found significant influence of social spending on Human Development Index (HDI) and Inequality-adjusted HDI, using the panel data of 55 low income and middle-income countries (so those with rather poor institutions). Furthermore, in contrary to earlier studies they did not find compelling evidence on the impact of governance on the effectiveness of outlays. Piabuo & Tieguhong (2017) assessed the links between health expenditures in African countries and GDP growth and concluded that there is two-directional causality between health spending and economic growth. They also underline the role of governance in the transmission of increases in health expenditures into the economic growth.

4.3 Assessment of Efficiency: A Review

In case of healthcare system studies at the country level, these are usually life expectancy at birth and maternal or infant mortality. There are several studies aiming at the assessment of the efficiency of health expenditures at the country level and determinants of this efficiency. Early analysis by WHO (Evans et al., 2000) presents the country-level analysis for almost 200 countries, using all three most popular techniques (SFA, DEA, FDH) and conclude that efficiency is lower in countries with poor governance and plagued by conflicts, but also the prevalence of HIV is important factor. In addition to that, authors found that the performance score of countries with lower expenditures is less favourable. They even show that it is very difficult to achieve any improvement in health indicators if outlays are lower than 60$ per capita (in 1997 international dollars). Greene (2004) argues that unobserved heterogeneity between countries is sometimes masked as inefficiency and accounting for this unobserved heterogeneity can significantly alter rankings of countries. Also, he confirms the positive relationship between total expenditures and efficiency. Grigoli & Kapsoli (2017) extend the earlier analysis by controlling for the socioeconomic and environmental factors that affects health outcomes and confirm that the largest room for improvement is observed in Africa, while Western and Asian countries are somehow more efficient. In addition to that, they suggest that increase in spending directed at controlling tuberculosis can lead to increase in efficiency. Sun et al. (2017) estimate the efficiency for healthcare sector in 173 countries with DEA method and perform econometric analysis to find determinants of health system efficiency. They conclude that generous social protection expenditures and good quality of governance boost the efficiency. While the latter is consistent with other studies, the former suggests that there are synergy effects between health and social protection expenditures. All studies cited above used either life expectancy (also healthy life

expectancy or disability-adjusted health expectancy) or mortality rate (child, infant or maternal mortality) as output indicators and expenditures per capita (usually PPP-adjusted) as input.

In case of efficiency in education, the literature is much more diverse. De Witte & López-Torres (2015) present the extensive review of literature on the efficiency in education sector measured at the different levels and with different inputs/outputs. They show that most of studies are performed at the unit level (university or school), and papers analysing the efficiency at the country level are relatively rare. Furthermore, they underline the importance of recent advancements in data availability (resulting from more popular data on education outcomes from PISA, TIMMS or PIRLS studies) and the need for better assessment of efficiency in education at the country level. Example of such study is Agasisti (2014), who use EU data on PISA tests results to assess the efficiency of education expenditures in the EU and its determinants. It turned out, that indeed the growth of education investments do not automatically translate into higher test scores (which is in line with earlier studies by e.g. Hanushek (2003), but some relationships between the characteristics of education system and efficiency were found – better students technical literacy and higher teacher salaries translated into more favourable efficiency scores, suggesting that human capital in education is indeed important factor shaping the efficiency of the sector. Interestingly, his results suggest no statistically significant link between equity and effectiveness. Giménez et al. (2017) uses two waves of PISA (2003 and 2012) to decompose changes in education performance to changes in efficiency and technical change (movement of frontier) and Aristovnik & Obadić (2014) applies DEA to assess the efficiency of secondary education in European countries. They are using not only education expenditures, but also pupil-teacher ratio and school enrollment as inputs.

While test results are the golden standard in measuring education outcomes, the data availability significantly constraints the possibility of cross-country or intertemporal analysis. Therefore, there are studies that use worse indicators, but with more significant country coverage, especially for developing countries which do not perform tests that often. For instance, Hauner and Kyobe (2010) use enrollment rates and completion rates to determine the efficiency in the education sector and conclude that efficiency declines with the level of expenditures (in contrary to health investment) and is positively correlated with financial depth and quality of governance. Herrera & Ouedraogo (2018) argue that PISA scores are correlated with net enrollment and average years of schooling and use these indicators (and the first level completion rate) as the measure of output in the education. They show that education efficiency scores depend to large extend on income inequalities. Grigoli (2014) uses net enrollment rate and adopts the hybrid approach to the measurement of efficiency, merging DEA and SFA – in that method DEA is used to compute the frontier, but LOESS function is used to account for the measurement error. His findings are broadly in line with previous research that found that efficiency is lower in low-income countries. Other results on the determinants of efficiency are similar – improving institutions should bring more efficiency, but also ease of access is important. Consequently, improvement of transport infrastructure to decrease the cost of accessing education facilities should also boost the efficiency of government expenditures.

The literature on the efficiency of social protection expenditures is much less abundant than in case of health and education. One possible explanation is the less direct link between social protection expenditures and outcome indicators, another is the lack of reliable data on broad set of indicators. Jafarov & Gunnarsson (2008) estimate the efficiency of social protection expenditures in Croatia and use DEA analysis with public expenditures on social benefits as input and percentage difference in poverty rate before and after tax and transfers as an output. With such setting, the relatively poorer countries achieve better results, because their spending may be low in nominal terms, but constitute significant part of government budget or GDP. Also, data on pre- and post-tax poverty rates are unavailable for broad sample of Arab countries. Hu et. al (2019) in his analysis on the efficiency of social expenditures in China provinces uses benefits coverage (as a percentage of population) or benefits coverage gap between urban and rural areas as social protection indicator in the DEA study, but this indicator is also not ideal, because it describes overall benefits coverage, but not how this coverage is related to needs.

Expenditures on environmental protection are rarely counted as a social outlay – however there are some studies aiming at the assessment of efficiency of specific policies, but usually in cost-efficiency framework. There are, however, some examples of using methods similar to these cited for education or healthcare sectors. Sueyoshi et al. (2017) presents literature review of 693 examples of literature work using the DEA for energy and environment assessment. Similarly to education sector, where efficiency studies in general concentrated on schools and education where the units were hospitals, in case of energy and environment sector, this is concentrated on power plants or company levels (e.g. Arocena (2008), Nag (2006) or Çelen (2013) in case of energy, Bolandnazar et al. (2014) or Khoshroo et al. (2013) for agriculture production at the farms level). However, there are some studies at the more general levels e.g. Azadeh et al. (2007) performs DEA studies of energy efficiency at the sectoral level with output indicators based on value added but enhanced with sector specific physical indicators. At the country level, Bampatsou et al. (2013) compute technical efficiency indicators for 15 EU countries between 1980 and 2008. In their case, the decision-making units (DMU) is country (or economic system), the input indicators are indices of fossil-energy use and renewable energy use and the output indicator is GDP index – the technical efficiency is computed over time. Camarero et al. (2014) perform similar exercise using the data on GHG emissions and treating GDP as an output. Cui & Li (2015) analyze the carbon efficiency of the transport sector at the country level using DEA. In their paper, they use freight and passenger turnover as an output indicator and labour, capital and carbon as input indices. They studied the determinants of efficiency and found out that R&D expenditures and government focus on low-carbon transportation can increase efficiency of that sector. Hoang & Alauddin (2011) apply DEA methodology to agriculture (national systems of livestock and crops production) in 30 OECD countries using different agricultural inputs (feed, seed, fertilizers, capital, labour, land, machinery etc.) and the quantitative, price-weighted index of output and conclude that there is a huge room for sustainability improvements in OECD agriculture. Furthermore, the efficiency in that sector is correlated with both the structure of industry and implemented agro-environmental policies such

as farming subsidies, subsidies to control nitrate pollution or support for farmers who agree to introduce sustainable agricultural practices.

In general, most efficiency studies in environmental area are constructed such that economic outcomes (or physical output measures) serves as an output in the production model and environmental impact (such as pollution emissions or environmental impact) are used as an input or undesired output. Some examples of such studies were cited in the previous paragraph. Lozano & Gutiérrez (2008) presents the application of DEA to Kaya identity, which decomposes changes to greenhouse gas emission into changes to GDP, energy efficiency and emission efficiency of energy production to analyze how much GDP can increase with constant level of emission or what reductions can be achieved with given GDP level. Zhou et al. (2006) and Wang et al. (2013) use GDP as desirable output and carbon emissions as undesirable one, producing the efficiency index with respect to carbon emission. In the similar vein, Zhang et al. (2015) add to this sulfur dioxide emission and chemical oxygen demand that measures water pollution. Such analyses however do not *explicitly* answer the question of the efficiency of environmental spending.

There are also some literature aiming at the overall assessment of the efficiency of social expenditures. In the recent paper, IMF(2020) concludes that social expenditures does indeed affect the social outcomes measured by such indicators as school enrolment and years of schooling in case of education, life expectancy and health mortality for health and Human Development Index (HDI) or poverty rate to measure overall impact of social spending on welfare. They conclude that while these expenditures can improve outcome, the substantial increase in efficiency can be achieved through controlling corruption, improvements in governance, financial deepening and increase in coverage. Furthermore, they stress the need for better data to further examine the efficiency of social spending. Antonelli & De Bonis (2018) employ the FDH and DEA methods to assess the efficiency of social expenditures in Europe based on the aggregate social protection performance index. They conclude that efficiency is negatively affected by the corruption index and population size, while positively by GDP per capita and education attainment of population. Afonso et al. (2010) construct public sector performance (PSP) and public sector efficiency (PSE) indices and apply the DEA method to calculate efficiency scores based on performance. In their study, the average efficiency is very low – countries could save on average 45% of their state budget if they move to the efficiency frontier. Their results on the determinants of public sector efficiency are largely in line with previous research – it is positively correlated with GDP *per capita*, education levels, quality of public sector and security of property rights.

4.4 Model and Rationale

Based on our assessment, we arrived at set of indicators for which data are available and credible for efficiency analysis. We aim to use 127 countries globally for this analysis, 15 are from the Arab region. The input and output variables with respect to our framework of analysis are the following in Table 1.

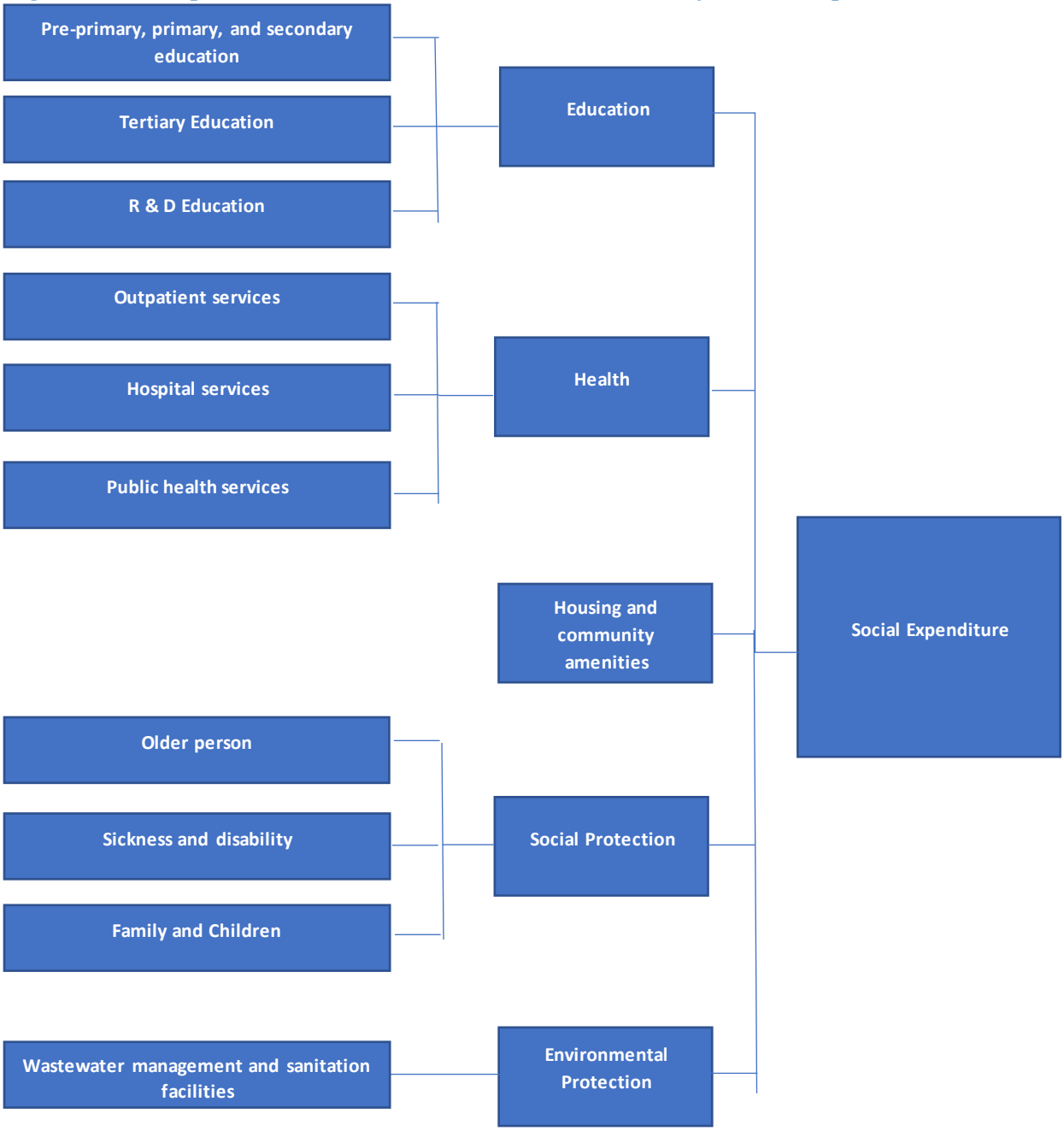
Table 1: Input and output variables for assessment of efficiency of social expenditures

	Input Variable	Output Variable
Social expenditure	Total social expenditure	Inequality-adjusted HDI
Education	Overall education expenditure	Expected years of schooling
	Pre-primary, primary, and secondary education	Pupil-teacher ratio, primary
	Tertiary education	Pupil-teacher ratio, tertiary
	R & D education	Harmonized test scores
Health	Overall health expenditure	Life expectancy at birth, total years
	Outpatient services	Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70%
	Hospital services	Mortality rate, infant per 1,000 live births
	Public health services	Prevalence of anemia among pregnant women %
Housing and community amenities	Overall housing and community amenities expenditure	Population living in slums % of urban population
Social protection	Overall social protection expenditure	Prevalence of undernourishment % population
	Older person	Proportion of population above statutory retirement age covered by benefit
	Sickness and disability	Proportion of population with severe disability covered by benefit
	Family and children	Prevalence of anemia among women of reproductive age % of women ages 15-49
Environmental Protection	Overall environment protection expenditure	Environmental Protection Index (EPI)

Note: The choice of indicator and its linkage to outcome is driven partly by conceptual analysis and partly by the data coverage. For example, outcome of education expenditures relating to the quality of schooling are unfortunately not available or not adequate to analyse such assessments. Therefore, teacher-pupil ratio is taken as a proxy to indicate that higher public expenditure on education would improve teacher-pupil ration, which improves quality of education in general.

This framework can be schematically depicted as in Figure 16.

Figure 16: Conceptual framework for the assessment of efficiency of social expenditures



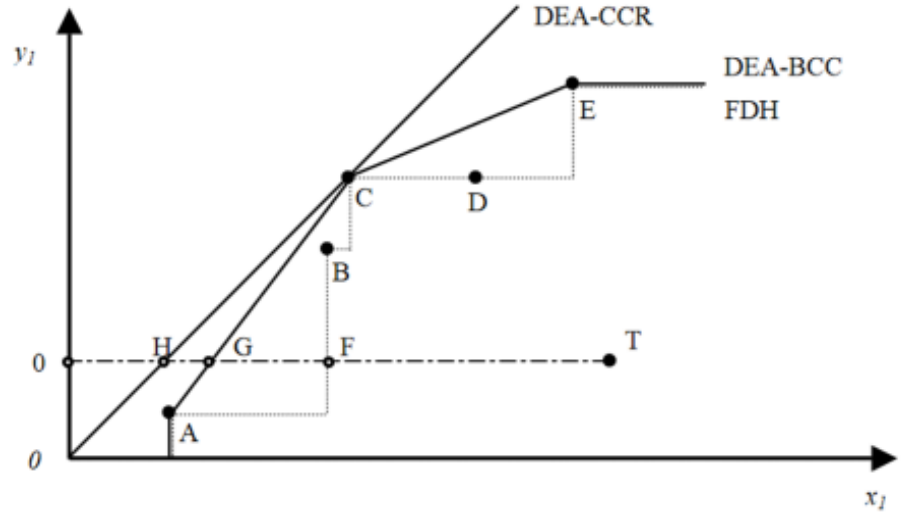
Three methods to assess the efficiency of government expenditures are commonly used in the literature: Data Envelopment Analysis (DEA), Free Disposal Hull (FDH) and Stochastic Frontier Analysis (SFA). All methods share some of the same key features.[10] Countries are plotted with the input indicator (overall or sectoral expenditures) on the x-axis and the corresponding output indicator on the y-axis. This enables the construction of a "frontier" of most efficient countries which possess high outputs relative to the level of inputs. Conceptually, countries located close to the frontier are relatively efficient and will receive high efficiency scores, while countries far from the frontier are relatively inefficient and will receive low scores. Countries that lie on the frontier receive the maximum efficiency score of 1.

The exact specifications of the frontier are determined by the choice of DEA, FDH, or SFA. SFA requires defining a functional form for the production function and the estimation of parameters. The SFA frontier is then defined as the possible combinations of inputs and outputs defined by the production function. Inefficient countries are ones that produce fewer outputs than the function predicts given their level of inputs (or equivalently, employ more inputs than the function suggests given their level of output). Due to the nature of social expenditure and the challenges of defining an appropriate production function to relate social expenditures to an array of diverse developmental outcomes, we dismiss SFA in this case and turn to DEA and FDH, which have the advantage of being nonparametric approaches.

While DEA and FDH are similar in many ways, the main difference between the two is that DEA assumes convexity of the production set while FDH does not. In DEA, there is an option to also assume constant returns to scale. The frontier with constant returns to scale is labeled DEA-CCR in the figure below. However, because the returns to education and healthcare have decreasing returns to scale, we opt for a framework that allows for variable returns to scale. This frontier (DEA-BCC) is constructed by connecting a subset of the top-most and leftmost countries on the input-output scatter plot with straight line segments such that the resulting frontier is convex. This implies that if A and B are consecutive countries located on the frontier, then any linear combination located between A and B also lies on the frontier. Since FDH relaxes the convexity assumption, the FDH frontier appears "stepwise." Under the FDH method, any country X that does not have another country Y that produces more outputs with fewer inputs will lie on the frontier. This is not necessarily the case under DEA. Figure 17 below shows the difference between the DEA-BCC frontier and the dashed, stepwise FDH frontier. Countries B and D lie on the FDH frontier but are inside the DEA frontier. Therefore, B and D will possess the maximum efficiency score of 1 under FDH but will receive scores less than 1 if DEA is used.

[10] See a more detail discussion of methodology of assessing efficiency and its decomposition in the Annex 3.

Figure 17: Efficiency Frontiers under DEA with Constant and Variable Returns to Scale and FDH



Source: Wang et al. (2003)

Regarding the choice between DEA and FDH, Lovell (1993) observes that DEA is preferable to FDH if the analysis is most concerned with nature of scale and substitution and transformation of inputs. In the context of social expenditure, this is a critical attribute as countries decide the level and distribution of social expenditure. Additionally, "slacks," which occur when shadow prices are zero, are less pervasive under DEA than FDH. Zero shadow prices can lead to an overstatement of technical efficiency and distort rankings of countries. When overall, system-wide comparisons are made the slacks are virtually non-existent in DEA. These slacks may appear only with the very high-end distribution of expenditures, which may be justifiable in our case. For example, in the health system, if the expenditures are more focused on improving the comfort and experience of patients than on improving outputs. For these reasons, we use DEA to construct our efficiency frontiers.

However, there are cases where FDH is preferable to DEA. First, the FDH frontier envelopes the data more closely than that of DEA. This implies that FDH can more accurately pinpoint the set of truly inefficient countries, as it minimizes the number of points inside the frontier. The interpretation and calculation of efficiency is also slightly simpler under FDH: any inefficient country is dominated by at least one another country which produces more output using fewer inputs, and due to the FDH frontier's stepwise nature, each efficiency score is calculated in relation to a specific dominant country. While these advantages to FDH were considered, DEA was found to more appropriate, given the pervasiveness of slacks under FDH and the overall goal of the analysis to issue specific recommendations regarding the level and composition of social expenditure.

4.4.1 Input and output efficiency

Once an approach is selected and the efficiency frontier is defined, another methodological consideration is the distinction between output and input efficiency. Output efficiency scores measure the amount of additional output that could be achieved if the country were more efficient. Graphically, output efficiency can be represented as the vertical distance between a country and the efficiency frontier: the greater the distance, the more inefficiency. For example, suppose country A and country B both have inputs of 100, have outputs of 100 and 60 respectively, and country A is on the frontier. Country A would have an efficiency score of 100/100 = 1 and country B would possess an output efficiency score of 60/100 = 0.6.

By contrast, input efficiency measures the potential reduction in inputs that could be achieved if the country became more efficient. An efficiency score less than one reflects the fact that fewer resources could be employed to produce the same output. On the chart, input efficiency is represented by the horizontal distance between the frontier and the given country, where countries far to the right of the frontier are more inefficient.

In our analysis, we find that output efficiency gives better results and is more interpretable. It is straightforward that a country could achieve better outcomes through improved efficiency, but for logistical reasons, using improved efficiency to reduce inputs would be complicated in practice. Therefore, we use output efficiency as the basis for calculating efficiency scores.

4.4.2 Normalized Indicators

The efficiency scores were calculated based on inputs in the form of expenditures as a percentage of GDP and normalized output indicators. They were calculated using the output-oriented DEA method, separately for each year, using three-year moving averages of the indicators. Two inputs are used for each outcome indicator:

(1) given sectoral expenditure on the indicator that directly impacts the outcome,
(2) other social expenditures (calculated as total social expenditures – sectoral expenditures) that impact indirectly to the outcome since overall social expenditure has an indirect impact on inclusive development.

Outcome indicators were normalized to 0-1 intervals by applying the following formula:

$$Normalized\ indicator = \frac{(V - min)}{(max - min)}$$

for indicators where the policy aim is to increase the value of the indicator; and:

$$Normalized\ indicator = -\frac{(V - min)}{(max - min)}$$

otherwise. V is the value of the indicator in a given country and year, max is the maximum and min is the minimum of the indicator for the given sample (including all countries and years).

The efficiency scores produced by DEA are within a 0 and 1 interval.

Within this paper, we present the following decomposition:

- Overall efficiency to education, health, social protection, housing and environmental protection components;
- Education efficiency to pre-primary, primary and secondary efficiency, tertiary efficiency and education R&D efficiency;
- Health efficiency to inpatient efficiency, outpatient efficiency, public health efficiency and health R&D.

5 Efficiency of Public Social Expenditure and Its Decomposition: Important Patterns and Drivers

5.1 Efficiency Scores and Changes Over Time

The overall efficiency of social expenditures in Arab region Is lower than the global average and decreased between 2013 and 2018. With 0.63 and 0.61 respectively, it is significantly below the global median of 0.76 and 0.74, let alone the ninetieth percentile. Therefore, there is huge scope for improvement – other countries managed to achieve much higher values of IHDI score for their social expenditures than Arab countries.

In case of education, the efficiency of Arab countries is significantly lower thank global average, regardless of the dimension. In addition to that, the average overall rank decreased between 2013 and 2018 from 0.79 to 0.77, marking the inability of Arab countries to get the value out of their money in terms of the expected years of schooling. However, the global mean and median also fell (from 0.85 to 0.84 and from 0.89 to 0.88 respectively), indicating the growing dispersion in the efficiency of education expenditures across the world. If components of education expenditures are considered, the Arab countries fare much better, especially in case of preprimary, primary and secondary education expenditures. The efficiency in this area in Arab region increased by 0.05 and reached global median of 0.94 – Arab countries managed to reach relatively high values of output indicator – pupil to teacher ratio for their values of expenditures. In case of both tertiary education and R&D, the efficiency of expenditures in Arab countries is significantly lower than world mean (0.91 and 0.43 compared to 0.93 and 0.64 respectively).

Table 2: Efficiency of public expenditure of Arab States vs global benchmarks (DEA)

		Arab mean		Global mean		Global median		Global 90th percentile	
		2013	**2018**	**2013**	**2018**	**2013**	**2018**	**2013**	**2018**
	Overall	0.63	0.61	0.69	0.71	0.76	0.74	0.97	0.98
Education	overall	0.79	0.77	0.85	0.84	0.89	0.88	0.99	0.99
	Pre-prim., prim. & secondary	0.89	0.94	0.91	0.92	0.94	0.95	1.00	1.00
	tertiary	0.91	0.91	0.93	0.93	0.94	0.94	1.00	0.99
	education R&D	0.40	0.43	0.74	0.64	0.77	0.71	1.00	1.00
Health	overall	0.86	0.89	0.85	0.87	0.87	0.88	0.98	0.97
	outpatient	0.75	0.86	0.84	0.85	0.88	0.91	1.00	1.00
	inpatient	0.93	0.96	0.95	0.96	0.98	0.99	1.00	1.00
	public health	0.94	0.96	0.94	0.95	0.98	0.98	1.00	1.00
	health R&D	0.45	0.49	0.37	0.43	0.32	0.36	0.85	0.93
Social protection	overall	0.97	0.95	0.94	0.94	1.00	1.00	1.00	1.00
	old age	0.39	0.54	0.82	0.89	0.98	1.00	1.00	1.00
	disability	n/a	0.07	0.86	0.77	1.00	1.00	1.00	1.00
	family	0.79	0.76	0.85	0.82	0.88	0.87	0.98	0.99
Environmental protection		n/a	0.70	n/a	0.68	n/a	0.73	n/a	1.00
Housing		0.83	0.70	0.74	0.77	0.79	0.86	0.98	1.00

Source: Own elaboration

Note: 1 in the 90th percentile column means that more than 10% of all DMUs are on efficiency frontier, 1 in the median column, means that more than half of DMUs are on the efficiency frontier.

The efficiency of expenditures in health sector increased in the Arab countries between 2013 and 2018 from 0.86 to 0.89 and was higher than global mean or median (0.87 and 0.88 respectively). As the outcome indicator for the overall health expenditures is life expectancy, the Arab countries are relatively efficient in turning their health expenditures into outcomes. This is mostly due to the better than average efficiency of outpatient spending and expenditures on public health (0.86 and 0.96 compared to 0.85 and 0.95). The efficiency of inpatient expenditures is in line with global benchmark at 0.96 , while public R&D spending are more efficient than global mean and median (at 0.49 compared to 0.43 and 0.36). Nevertheless, as the number of countries in the sample for health R&D spending is quite small, this result should be further examined.

The overall efficiency of social protection expenditures in Arab countries is relatively good, if we treat prevalence of undernourishment as the output indicator – in this case Arab countries are above global mean, though average efficiency decreased slightly from 0.97 to 0.95 between 2013 and 2018. That means that countries in the region succeeded in turning social spending into reduction of undernourishment. However, in case of different subcategories of social expenditures, the situation looks much worse – for the old-age expenditures, the average efficiency score is just 0.54

compared to 0.89 average globally. Global median in 2018 was 1, what indicates that more than half of the countries in the sample was on the efficiency frontier. That means, that despite its spending for the old-age benefits, the proportion of population above statutory retirement age covered by benefits is still very low. Even worse is the coverage of disability benefits, which cover very small proportion of disabled population. In contrary, the efficiency of family benefits, where the outcome indicator is prevalence of anemia among women in reproductive age is relatively better (0.76 efficiency score, while global mean is 0.82). The relatively good efficiency of family benefits contributes to favorable overall score.

The last two categories of expenditures are environmental protection (where efficiency is measured by the environmental performance index - EPI[11]) and housing with efficiency reflected by the percentage of urban population living in slums. In case of environmental protection, the average efficiency of Arab countries is higher than global (0.7 vs 0.68 respectively), while in case of housing it is lower (0.7 vs. 0.77). In both cases global mean is higher than median, what means that the distribution of efficiency is left skewed, what is standard property of the distribution of the efficiency score.-Also, for almost all categories the 90th percentile of the efficiency distribution is equal to one, what means that more than 10 per cent of countries lie on the DEA efficiency frontier.

5.2 Decomposition of efficiency scores

To examine, how the overall efficiency score depends on the scores within different categories, the parameters α_i of equation (2) can be estimated econometrically. In this section, the results of cross-country regressions of the efficiency versus its components will be presented for two techniques – stochastic frontier analysis and DEA. The efficiency of overall expenditures is decomposed as a sum of efficiencies in education, health, social protection, housing and environmental protection components, while the overall efficiency of education, health and social protection is decomposed into the impact of efficiency of different components.

In case of overall efficiency, the contribution of social protection, education and health are pretty similar with the largest contribution from social protection, followed by health spending and education expenditures. Housing and environmental protection efficiency did not have statistically significant contribution to the overall efficiency of social expenditures what is not surprising given the construction of IHDI index, which was the outcome indicators for the overall social expenditures efficiency. Furthermore, the sum of all coefficients is slightly lower than 1 what indicates slightly decreasing returns to scale – the closer to the overall efficiency frontier is the country, the more difficult it is to further increase efficiency. This finding is in line with the theoretical framework and the literature. In the other words, increasing the efficiency of social protection expenditures is will translate into the highest improvements in overall social expenditures though the differences with both health and education categories are not very large.

[11] https://epi.yale.edu/

Table 3: The decomposition of efficiency of social expenditures into different components.

	overall		Education		Health		Social protection	
	DEA	SF	DEA	SF	DEA	SF	DEA	SF
Education	0.230***	0.230**						
Health	0.366***	0.324***						
Social protection	0.394***	0.404***						
Housing	0.00222	-0.00842						
Environmental protection	0.0346	0.0613						
Preprimary, primary & secondary			0.385*	0.389*				
Tertiary			0.232*	0.228*				
Education R&D			0.159**	0.163**				
Outpatient					0.0193**	0.0325***		
Inpatient					0.0812***	0.0822***		
Public health					-0.0101	-0.0143		
Health R&D					-0.0239**	-0.0248**		
Old age							0.0312***	-0.000390
Disability benefits							0.0117***	-0.00804***
Family benefits							0.00882*	-0.00445***
Constant	1.304***	1.324***	0.981***	1.045***	-0.186**	-0.165**	0.0582***	-0.145***
Observations	47	46	44	44	43	43	52	51
R-squared	0.725	0.662	0.413	0.431	0.502	0.565	0.700	0.440

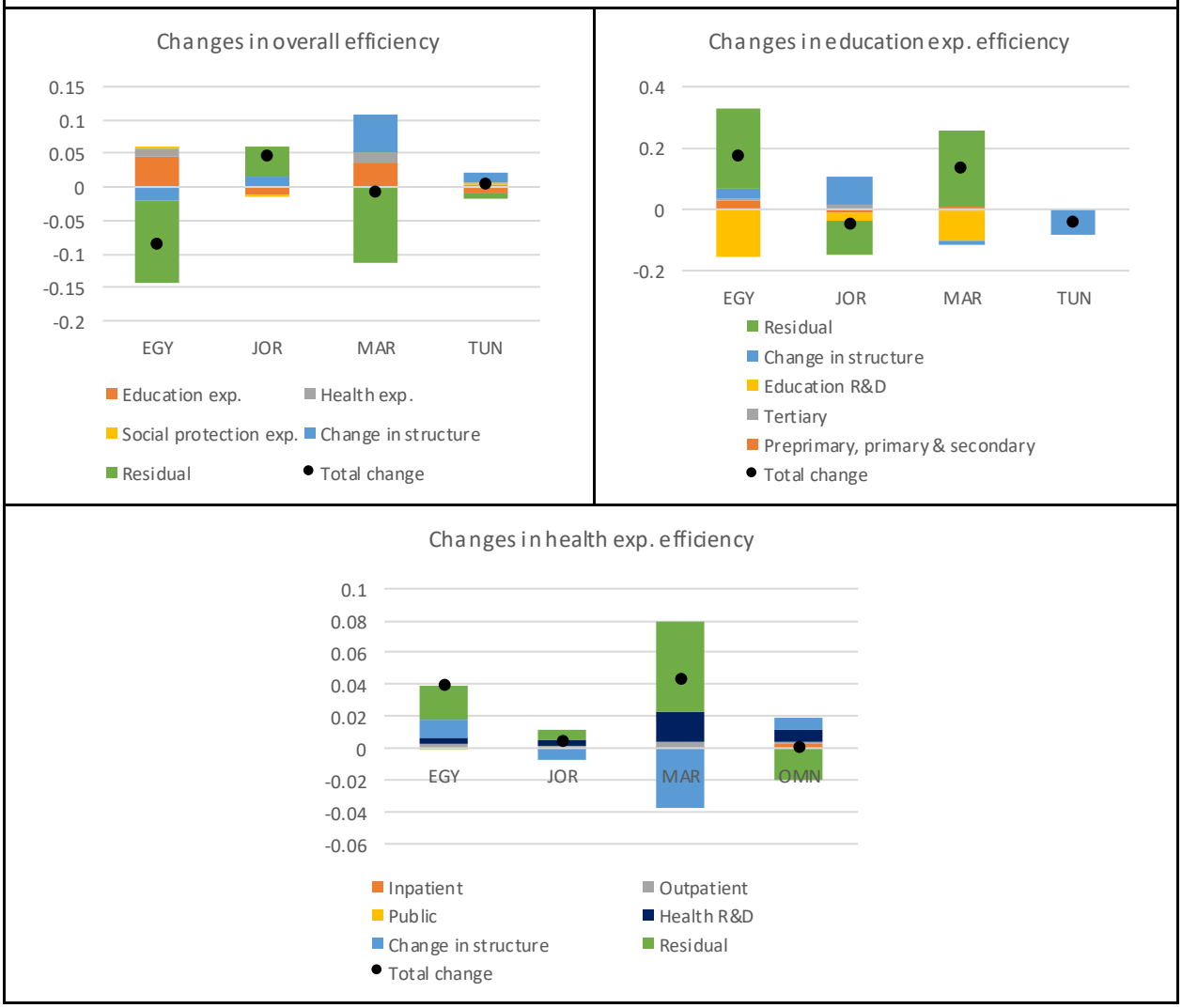
Source: Own elaboration
*Note: *** indicates significance at 1% level, **-5% level and *-10% level.*

Looking closer to the efficiency of education expenditures shows that the most significant influence is exerted by efficiency of pre-primary, primary and secondary spending with the coefficient equal to 0.38 (what means that 1% increase in the efficiency in this category will translate into 0.38% increase in the efficiency of overall education outlays). It is followed by tertiary education with coefficient equal to 0.23 and education R&D with the weight equal to 0.16. As in case of decomposition of overall efficiency, the returns to scale are therefore slightly decreasing, but the overall values of coefficients are in-line with theoretical predictions. This is not exactly the case of health expenditures – the values of coefficients are very low here indicating that improvement in efficiency in one of the categories is to limited extent translated into the improvement in efficiency of overall health system. The highest contribution is, however, recorded for inpatient health outlays. Similarly, for social protection efficiency the score for old-age benefits is the most significant and improvements in other categories do not translate into substantial change in the overall social protection efficiency.

All of these results hold regardless of whether the efficiency is measured with DEA score or stochastic frontier score.

The coefficients from the decomposition exercise can be used to show what factors drove the changes in efficiency at the country level between 2013 and 2018 in line with the equation (3). Only for four Arab countries, there is enough data to do such exercise for overall and education expenditures – Egypt, Jordan, Morocco and Tunisia. The decomposition of changes in health expenditures efficiency may be calculated for Oman, but not for Tunisia (Figure 18).

Figure 18: The decomposition of changes in efficiency in selected Arab countries between 2013 and 2018



Source: Own elaboration

In case of overall efficiency, the most visible effects are positive impact of changes in efficiency of education expenditures in Egypt and Morocco and positive contribution in changes to structure in Morocco (and to smaller extent, negative in Egypt). The influence of other factors is relatively minor. In case of changes in education expenditures, the most visible is the negative impact of

changes in efficiency of education R&D expenditures in Egypt and Morocco. Shifts in structure of education expenditures had somewhat positive influence in Egypt and Jordan and negative in Tunisia. Improvement in efficiency of health R&D positively contributed to the increase in overall health efficiency in all analyzed countries, while changes to structure exerted significant negative pressure in Morocco, less substantial, but still negative in Jordan, positive in Egypt and Oman. Other factors were of limited contribution.

All in all, the decomposition of changes in efficiency into the components provides some insights on the changes in the efficiency of social expenditures over the last couple of years. However, more research is needed to fully understand how efficiency depends on the changes in particular components of spending.

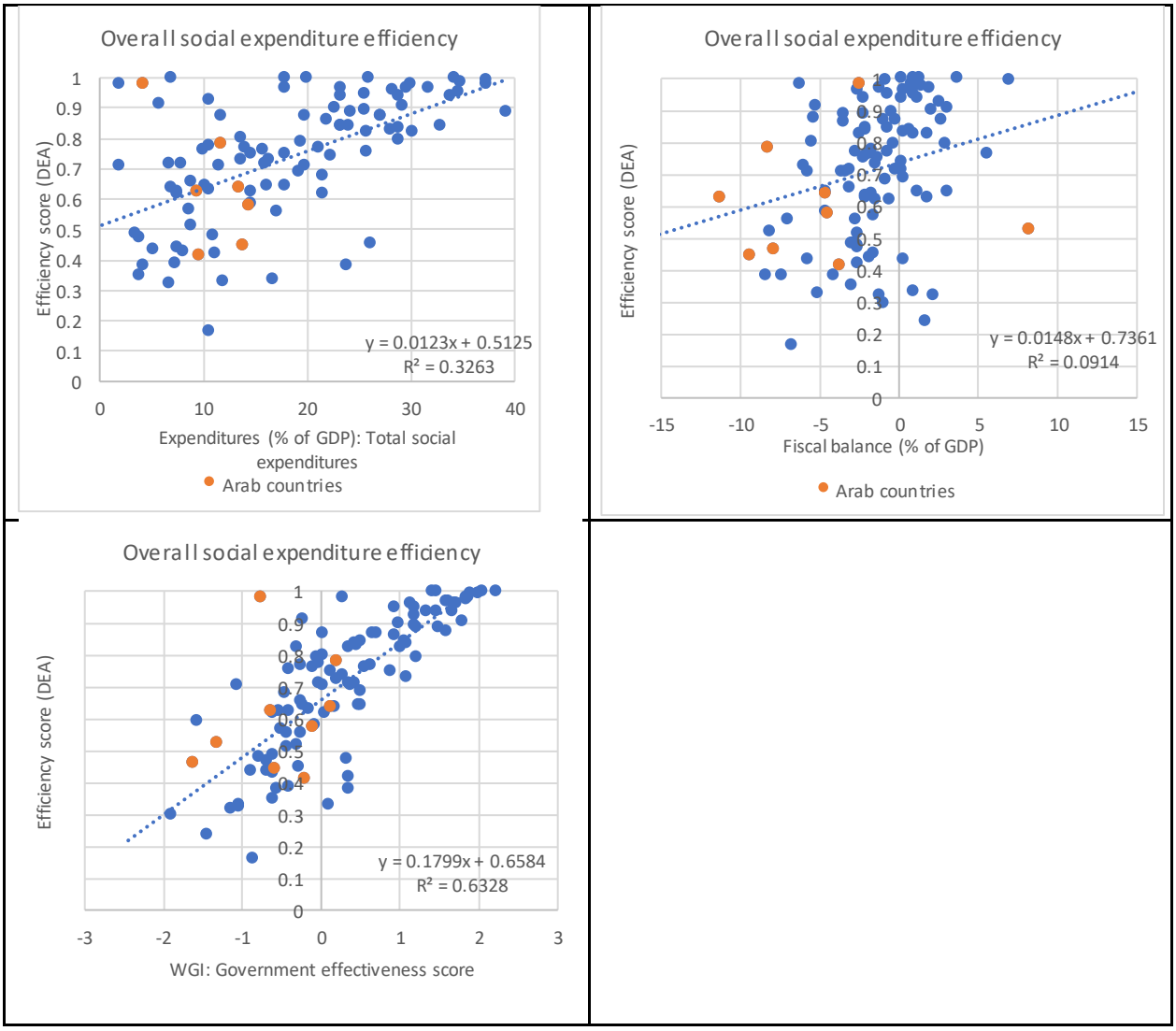
5.3 Association Between Efficiency and Public Expenditure Patterns

In this section, some stylized facts on the global distribution of efficiency are presented. Detailed analysis of the determinants of efficiency scores are beyond the scope of this paper.

The correlation between overall efficiency score and total expenditures as a percentage of GDP is visible though not very strong (the R^2 is equal to 33%). There is a visible cluster of high efficiency countries in the upper right corner of the chart (Figure 19) indicating that almost all countries with social expenditures exceeding about 25% of GDP are relatively efficient (efficiency above 0.8). Nevertheless, even states that cannot afford that level of social expenditures, can be efficient – Palestine is good example with overall efficiency score exceeding 97% and total social expenditures at 4.2 per cent of GDP.

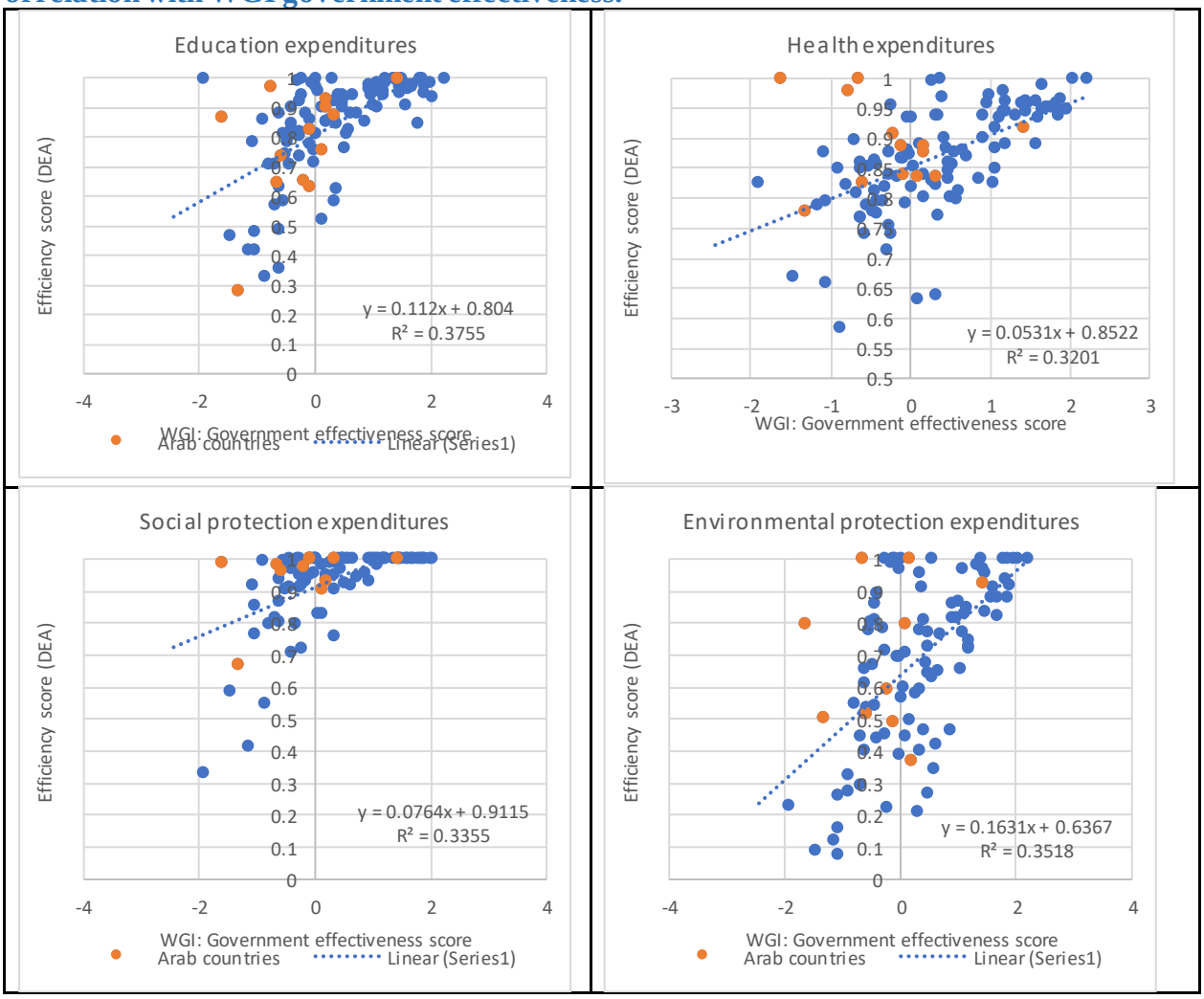
Furthermore, it may be assumed that countries with more fiscal discipline (as measured by the government fiscal balance) will be more efficient as they watch their expenditures more closely and have more fiscal space to allocate funds when they are mostly needed. This is only partially confirmed by the data – though the slope of regression line of efficiency score vs. fiscal balance is positive and statistically significant, the value of the coefficient is relatively low and the fiscal space explains only about 9 per cent of the overall variation in DEA score across countries. The government effectiveness score from World Governance Indicators (WGI) better predicts the overall efficiency of social expenditures than either fiscal balance or total social expenditures. Interestingly, here also the Palestine is outlier with high efficiency of social expenditures despite the low government effectiveness score (Figure 20). These results are in line with the literature on the determinants of efficiency of government spending.

Figure 199: The efficiency score for overall social efficiency and its correlation with different fiscal variables.



Source: Own elaboration

Figure 2020: The efficiency score for different dimension of social efficiency and its orrelation with WGI government effectiveness.

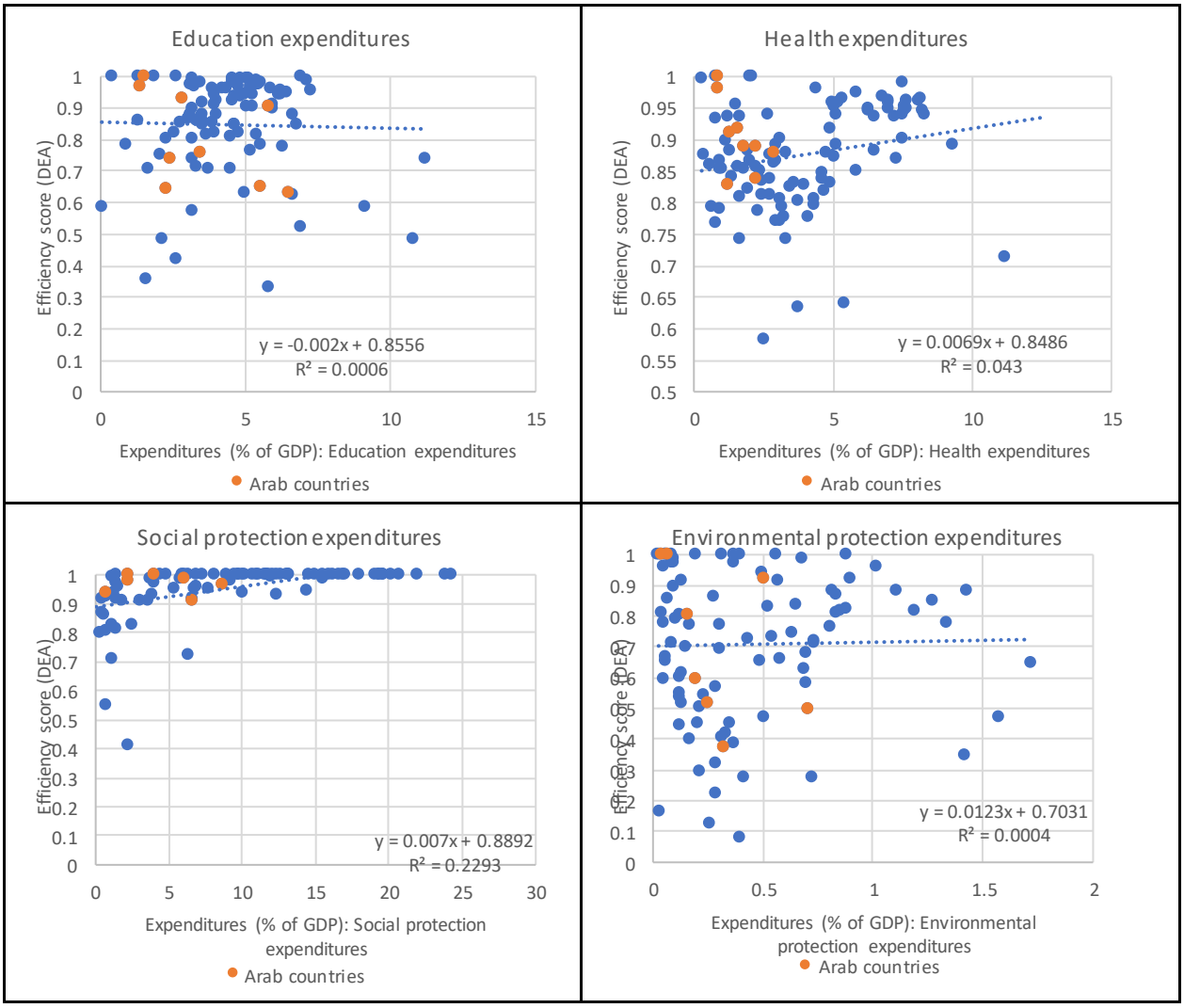


Source: Own elaboration

Similarly, to overall social protection, also the efficiency at the sectoral level is positively correlated with government effectiveness. The strength of the relationship is similar in all cases – education, health, social protection, environmental protection and housing with R^2 ranging between 32% and 40%. Consequently, government effectiveness uniformly affects the efficiency of expenditures in all dimensions of social policy.

The literature finding that efficiency is correlated with expenditures is confirmed for total social expenditures and, to limited extent for health and social protection expenditures (Figure 21). Nevertheless, in case of sectoral efficiency, the strength of the relationship is significantly weaker than the relationship between efficiency score and government effectiveness index, what suggest that the overall capacity of the government is more significant determinant of efficiency score than the size of the spending as such.

Figure 21: The efficiency score for different dimension of social efficiency and its correlation with selected expenditures



In addition to that, it should be noted that the correlation between the efficiency of sectoral social expenditures and fiscal balance is weak – consequently the relationship between efficiency and overall fiscal position or expenditure is much more complicated. The efficiency scores presented above may and should serve as a basis for additional forthcoming studies on the detailed determinants on sectoral efficiency.

6 Improving Efficiency of Public Social Expenditure: Policy Implications

The efficiency scores developed in the previous sections allow for the performance of policy simulations over time. Since outcomes are defined as a product of expenditures and efficiency, one can alter the inputs and study the projected changes to the output indicators. For example, a

country may want to determine the effect on expected years of schooling if educational spending is increased by 20%. Alternatively, the country might be interested to know the potential for bettering outcomes through efficiency improvements. In this scenario, expenditures can be fixed while efficiency is raised to a relevant benchmark, such as the average efficiency for HIC countries. The best results occur when spending increases are combined with efficiency improvements, but this is not always possible in every situation. Therefore, the efficiency simulations help countries to prioritize their efforts.

A different type of policy simulation involves fixing the output indicator at a predetermined level and assessing the possible combinations of spending and efficiency required to achieve the desired output. In this case, a country may be interested in the potential savings that can be achieved through improving efficiency. By fixing the output indicator as unchanged and raising the efficiency score to an appropriate benchmark, the simulation will calculate the amount of savings.

Results are presented for the policy simulations using the Jordan and Tunisia as examples. Generally, the simulations assessed 1) the improvements in SDG indicators that could be achieved if both countries increased social expenditures to global averages and raised efficiency to the average efficiency of HIC countries, and 2) the potential savings both countries could benefit from by substituting efficiency for expenditures. Key outcomes from the policy simulations are as follows:

6.1 Jordan

Overall Social Expenditure

If Jordan would increase its overall social expenditures by 24 per cent from current levels to match the global average of 16.6% of GDP, its IHDI would increase by 7 per cent (from 0.622 to 0.658). However, if Jordan adopted the same increase in social expenditure and improved its efficiency to match the average efficiency of HIC countries, its IHDI would increase from 0.622 to 0.727. This would raise Jordan's world IHDI ranking from 72nd to 46th out of a total 152 countries. If efficiency were improved to match the HIC global average, Jordan could reduce total public social expenditure by 28% (Figure 23), an annual savings of JOD 1.1 billion, without experiencing a reduction in its IHDI.

Figure 22: Policy simulation: Improving efficiency improves IHDI with same expenditure levels (Example – Jordan)

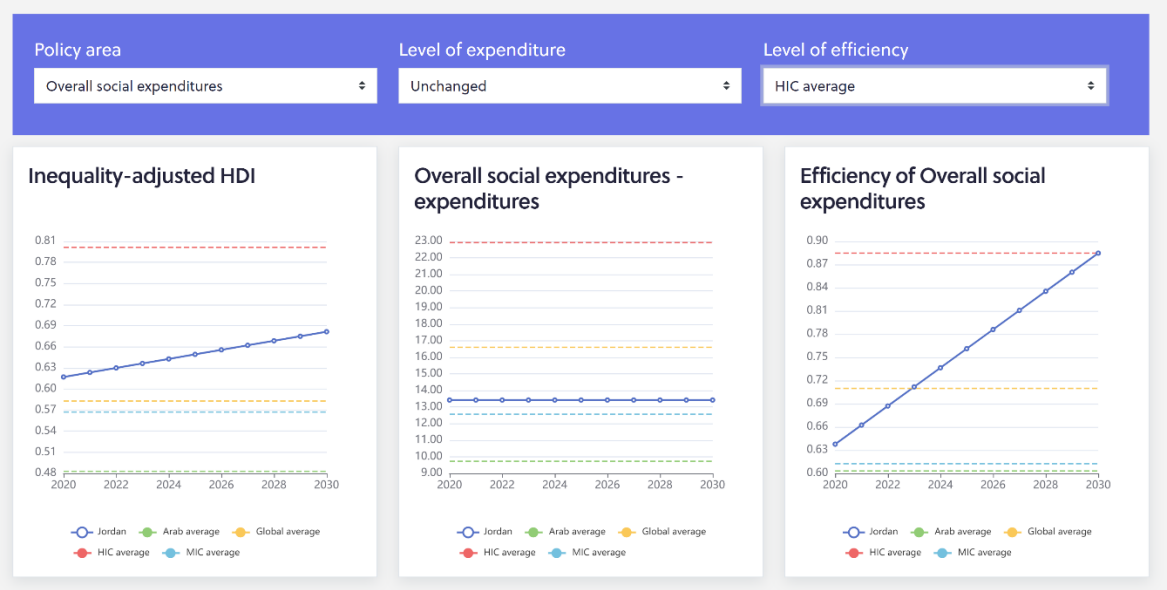
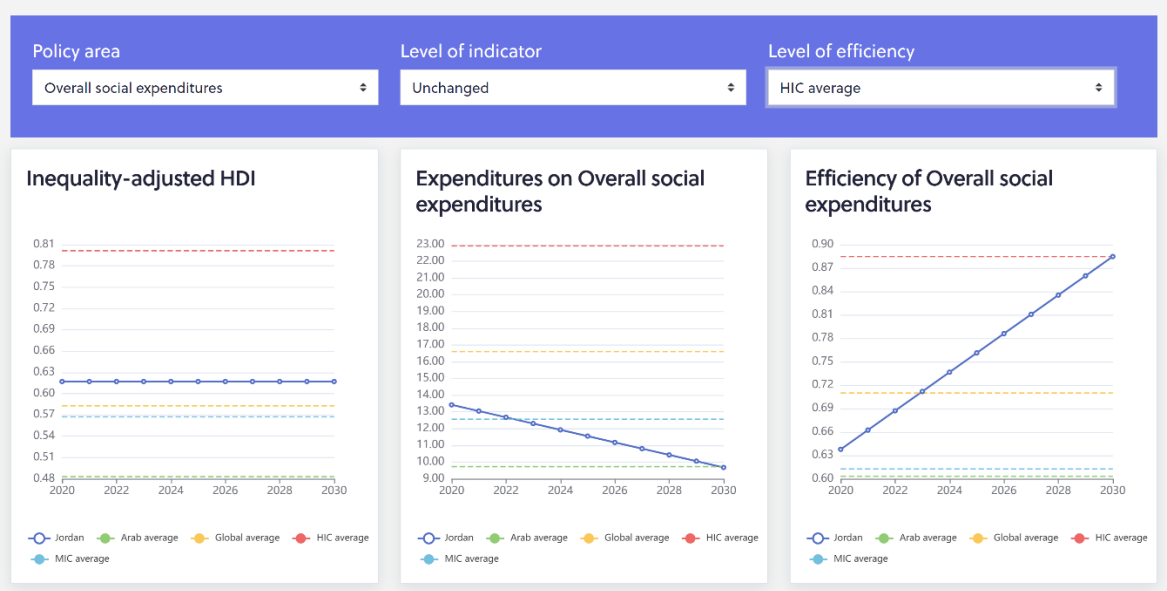


Figure 23: Policy simulation: Improving efficiency reduces expenditures to achieve the same level of IHDI (Example – Jordan)



Source: ESCWA Social Expenditure Monitor Dashboard

Education

Jordan would need to increase its public education spending by 27% to reach 4.4% of GDP, the global average for education expenditure. Under this level of spending, expected years of schooling would increase by roughly half a year, from 11.6 to 12.1 years. If at the same time, efficiency could be elevated to the HIC average efficiency, expected years of schooling would increase further to 12.7 years. If Jordan were to achieve the average education spending efficiency of HIC countries, education expenditures could be reduced 20% from current levels (a savings of JOD 220 million) without facing a reduction in expected years of schooling.

Health

If Jordan were to increase overall health expenditures by 65 per cent to match the global average, the country could add 2.6 years to life expectancy, an improvement from 74.4 years to 77.0 years. However, if at the same time, Jordan's health efficiency would increase to match the average efficiency for Arab countries, life expectancy would rise by an additional half of a year to 77.5. An increase in efficiency to match the HIC average would allow Jordan to maintain its current life expectancy while reducing its present level of health expenditures by 10 per cent, or JOD 73 million.

Social Protection

If Jordan would increase overall social protection expenditure by 17 per cent from its current level to meet the global average of 7.6% of GDP, Jordan's prevalence of undernourishment in the general population would decrease from 8.6% to 6.9%. However, if at the same time, the efficiency of social protection spending would increase to match the global average, the undernourishment rate would fall to 6.6%. This change implies there would be nearly one-quarter fewer undernourished people. Increasing the efficiency of overall social protection spending to the HIC average would allow Jordan to decrease social protection expenditures by 10 per cent without facing an increase in undernourishment. This represents a savings of JOD 198 million.

Environmental Protection

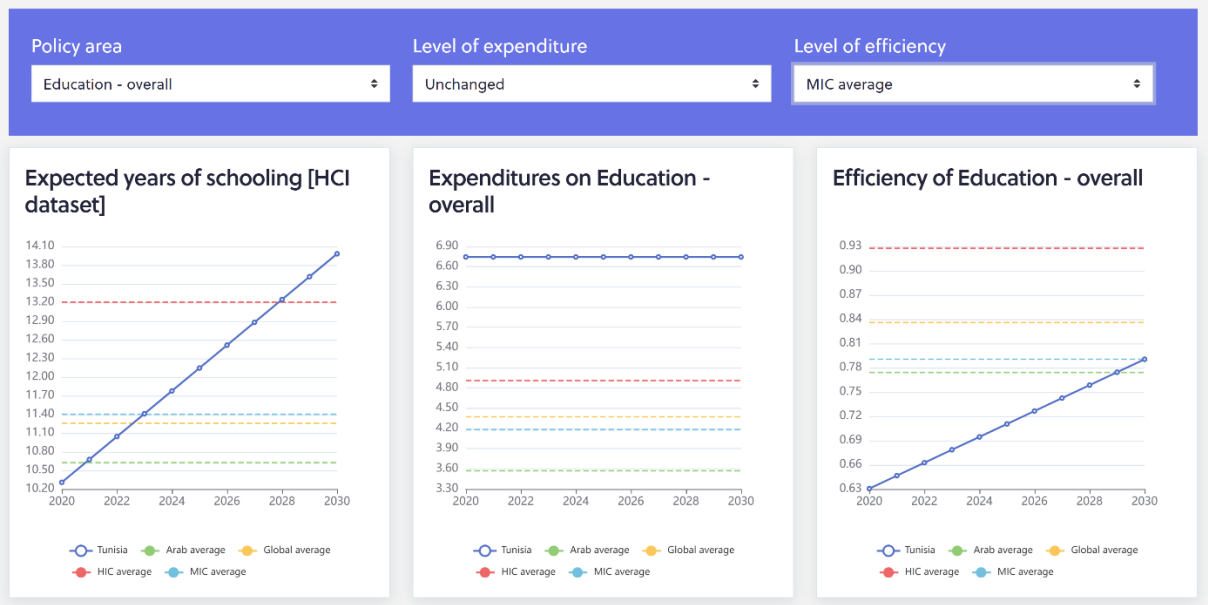
In the 2020 Environmental Performance Index (EPI) published by the Yale Center for Environmental Law and Policy, Jordan ranked 48thof 180 countries worldwide on overall environmental performance with a score of 53.4 If Jordan would increase its expenditure on environmental protection by 47 per cent to match MIC average, its EPI is projected to increase to 56.8, an improvement of 3.2 points. Jordan is quite efficient in its support to environmental protection, so there are limited gains to be made through redistribution of expenditures. Jordan's efficiency score for the environmental protection dimension is 0.8, which falls only slightly below the average for HIC countries of 0.82. However, Jordan spends 0.2% of GDP on environmental protection, far less than the global average of 0.5% of GDP and the HIC average of 0.7%. Simply maintaining Jordan's high spending efficiency under increased expenditure levels may prove a critical challenge.

6.2 Tunisia

Overall Social Expenditure

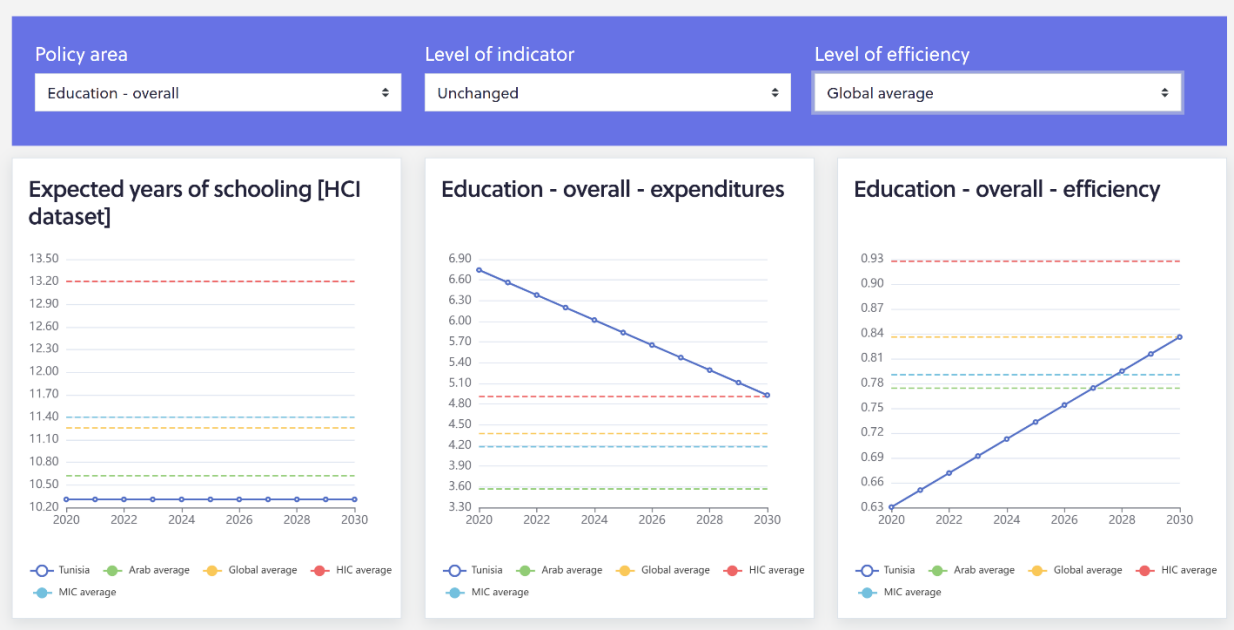
If Tunisia would increase its total social expenditure by 13% from current levels to match the global average of 16.6% of GDP, its IHDI score would increase by 5 per cent from 0.58 to 0.61. However, if Tunisia holds total social expenditure unchanged and improves its efficiency to match the average efficiency of HIC countries, its IHDI would increase by 17% (from 0.58 to 0.68). If the level of social expenditure is raised to the global mean of 16.6% of GDP in combination with improved efficiency, then IHDI would increase further to 0.71. This improvement would raise Tunisia's IHDI world ranking from 77th to 48th out of a total 152 countries. If efficiency is increased to match the HIC average and the level of IHDI is kept unchanged, then Tunisia can reduce total public social expenditure by 35%, an annual savings of TND 5.5 billion (Figure 25).

Figure 24: Policy simulation: Improving efficiency in education expenditure will lead Tunisia to improve its expected years of schooling to top levels globally



Source: ESCWA Social Expenditure Monitor Dashboard

Figure 25: Policy simulation: Improving efficiency reduces significant wastages in education expenditure without affecting achievement in expected years of schooling



Source: ESCWA Social Expenditure Monitor Dashboard

Education

Total education expenditures in Tunisia comprise 6.7% of GDP, which exceeds the average level of education expenditures for HIC and MIC countries (4.9% and 4.2% of GDP, respectively), as well as the global average of 4.3% of GDP. This suggests that Tunisia's level of education expenditure is sufficient to achieve desirable outcomes in education. If the increase of education efficiency to match HIC average is assumed and the expected years of schooling are kept unchanged, then Tunisia can reduce education expenditures by 35 per cent, or TND 2.5 billion, and maintain the current level of expected years of schooling.

Health

If Tunisia would increase its overall health expenditures from current levels to match the global average of 3.8% of GDP, its life expectancy would increase by 2.1 years, from 76.4 to 78.5. In addition, if Tunisia improved its efficiency to match the average efficiency of HIC countries, its life expectancy would increase by 0.15%, from 76.4 to 76.6 years. If the increase of efficiency to match HIC average is assumed and the life expectancy is kept unchanged, then Tunisia can save 4 per cent of its current expenditures on health. This amounts to TND 76 million.

Social Protection

Tunisia is already on the efficiency frontier if general social protection is considered. However, specific indicators of social protection may be considered. If Tunisia would increase its social protection expenditures on older persons to match the global average of 5.1% of GDP, its proportion of the population above the statutory pensionable retirement age covered by benefits would increase by 26% (from 54% to 80%). Also, if Tunisia does not change the level social expenditure and improves its efficiency to match the average efficiency of HIC countries, the same proportion would increase from 54% to 58%; if the level of expenditure matches the global average of 5.1% of GDP, then the rate would increase further to 85%.

Environmental Protection

Tunisia's expenditures on environmental protection represented 0.73% of GDP in 2018, which was exactly equal to the average expenditure of HIC countries. This suggests Tunisia's level of expenditures is sufficient to achieve desirable outcomes for environmental protection. However, if Tunisia increases efficiency from its current value of 0.50 to the HIC average benchmark of 0.82, then it could increase its Environmental Protection Index (EPI) by roughly 18 points, from 46.7 to 64.6. By increasing efficiency to the HIC average of 0.82, Tunisia could reduce expenditures on environmental protection by TND 320 million (or 41%) without experiencing a negative impact on environmental outcomes.

7 Conclusion

The average efficiency of social expenditures of many Arab states is lower than the global average, as well as the benchmark of high-income countries' (HIC) average or average of middle-income countries (MICs) globally. This suggests that Arab countries have potential to achieve higher levels of achievement in inequality adjusted human development, as a broad indicator of human wellbeing, as well as other indicators of social development, without needing to increase spending.

The average efficiency of public expenditures on education in Arab states is lower than the averages for global, HIC, or MIC country groups. This implies Arab countries achieve fewer expected years of education than their global peers relative to their spending levels.

Efficiency scores for health expenditures are higher than that noted in case of education. Arab countries lag only the HIC average. This can be explained due to very low public expenditures on both public health services and outpatient services, as out-of-pocket expenditures is high in these sectors. As a result, Arab countries achieve relatively good outcomes with low public expenditures on health as compared to the other country groups.

Public social protection expenditures in the Arab states are, on average, relatively effective. The prevalence of undernourishment is relatively low even though the region has low expenditures on social protection.

The efficiency of housing, connectivity, and community amenities expenditures in Arab countries is lower than global average, HIC average or MIC average, while regional housing spending is (as a percentage of GDP) higher than relevant global benchmarks, the proportion of urban population living in slums is still very high.

The efficiency of environmental protection expenditures is relatively high. This is, however, due to the very low expenditures, as in terms of outcome (environmental protection index), Arab countries are below global average.

The findings of efficiency analysis suggest that improving social expenditure efficiency is essential to improve outcomes, given the budget rigidities, limited fiscal space and shortage of liquidity faced by most countries in the region.

Assessment of efficiency would help identifying gaps and facilitate in minimizing wastages and saving resources for reallocation to target neediest areas of development.

References

Arocena, Pablo. "Cost and Quality Gains from Diversification and Vertical Integration in the Electricity Industry: A DEA Approach." *Energy Economics* 30, no. 1 (January 1, 2008): 39–58. https://doi.org/10.1016/j.eneco.2006.09.001.

Bampatsou, Christina, Savas Papadopoulos, and Efthimios Zervas. "Technical Efficiency of Economic Systems of EU-15 Countries Based on Energy Consumption." *Energy Policy*, Special section: Long Run Transitions to Sustainable Economic Structures in the European Union and Beyond, 55 (April 1, 2013): 426–34. https://doi.org/10.1016/j.enpol.2012.12.021.

R.D. Banker, A. Charnes, W.W. Cooper, Some models for estimating technical and scale inefficiencies in data envelopment analysis, Manag. Sci. 30 (1984) 1078—1092.

Bolandnazar, E., A. Keyhani, and M. Omid. "Determination of Efficient and Inefficient Greenhouse Cucumber Producers Using Data Envelopment Analysis Approach, a Case Study: Jiroft City in Iran." *Journal of Cleaner Production* 79 (September 15, 2014): 108–15. https://doi.org/10.1016/j.jclepro.2014.05.027.

Boyd, Gale A., and Joseph X. Pang. "Estimating the Linkage between Energy Efficiency and Productivity." *Energy Policy* 28, no. 5 (May 1, 2000): 289–96. https://doi.org/10.1016/S0301-4215(00)00016-1.

Camarero, Mariam, Juana Castillo-Giménez, Andrés J. Picazo-Tadeo, and Cecilio Tamarit. "Is Eco-Efficiency in Greenhouse Gas Emissions Converging among European Union Countries?" *Empirical Economics* 47, no. 1 (August 1, 2014): 143–68. https://doi.org/10.1007/s00181-013-0734-1.

Çelen, Aydın. "Efficiency and Productivity (Tfp) of the Turkish Electricity Distribution Companies: An Application of Two-Stage (Dea&tobit) Analysis." *Energy Policy* 63 (December 1, 2013): 300–310. https://doi.org/10.1016/j.enpol.2013.09.034.

Cui, Qiang, and Ye Li. "An Empirical Study on the Influencing Factors of Transportation Carbon Efficiency: Evidences from Fifteen Countries." *Applied Energy* 141 (March 1, 2015): 209–17. https://doi.org/10.1016/j.apenergy.2014.12.040.

Hoang, Viet-Ngu, and Mohammad Alauddin. "Input-Orientated Data Envelopment Analysis Framework for Measuring and Decomposing Economic, Environmental and Ecological Efficiency: An Application to Oecd Agriculture." *Environmental and Resource Economics* 51, no. 3 (March 1, 2012): 431–52. https://doi.org/10.1007/s10640-011-9506-6.

Khoshroo, Alireza, Richard Mulwa, Ali Emrouznejad, and Behrouz Arabi. "A Non-Parametric Data Envelopment Analysis Approach for Improving Energy Efficiency of Grape Production." *Energy* 63 (December 15, 2013): 189–94. https://doi.org/10.1016/j.energy.2013.09.021.

Lozano, Sebastián, and Ester Gutiérrez. "Non-Parametric Frontier Approach to Modelling the Relationships among Population, GDP, Energy Consumption and CO2 Emissions." *Ecological Economics* 66, no. 4 (July 15, 2008): 687–99. https://doi.org/10.1016/j.ecolecon.2007.11.003.

Nag, Barnali. "Estimation of Carbon Baselines for Power Generation in India: The Supply Side Approach." *Energy Policy* 34, no. 12 (August 2006): 1399–1410. https://doi.org/10.1016/j.enpol.2004.09.011.

Sueyoshi, Toshiyuki, Yan Yuan, and Mika Goto. "A Literature Study for DEA Applied to Energy and Environment." *Energy Economics* 62 (February 1, 2017): 104–24. https://doi.org/10.1016/j.eneco.2016.11.006.

Wang, Ling, Zhongchang Chen, Dalai Ma, and Pei Zhao. "Measuring Carbon Emissions Performance in 123 Countries: Application of Minimum Distance to the Strong Efficiency Frontier Analysis." *Sustainability* 5, no. 12 (December 2013): 5319–32. https://doi.org/10.3390/su5125319.

Ward, J. M. *Measuring and assessing capacity in fisheries*. Vol. 433. Food & Agriculture Org., 2003, Rome 2003

Wang, T. F., Song, D. W., & Cullinane, K. (2003). Container port production efficiency: a comparative study of DEA and FDH approaches. *Journal of the Eastern Asia Society for Transportation Studies*, *5*(10), 698-713.

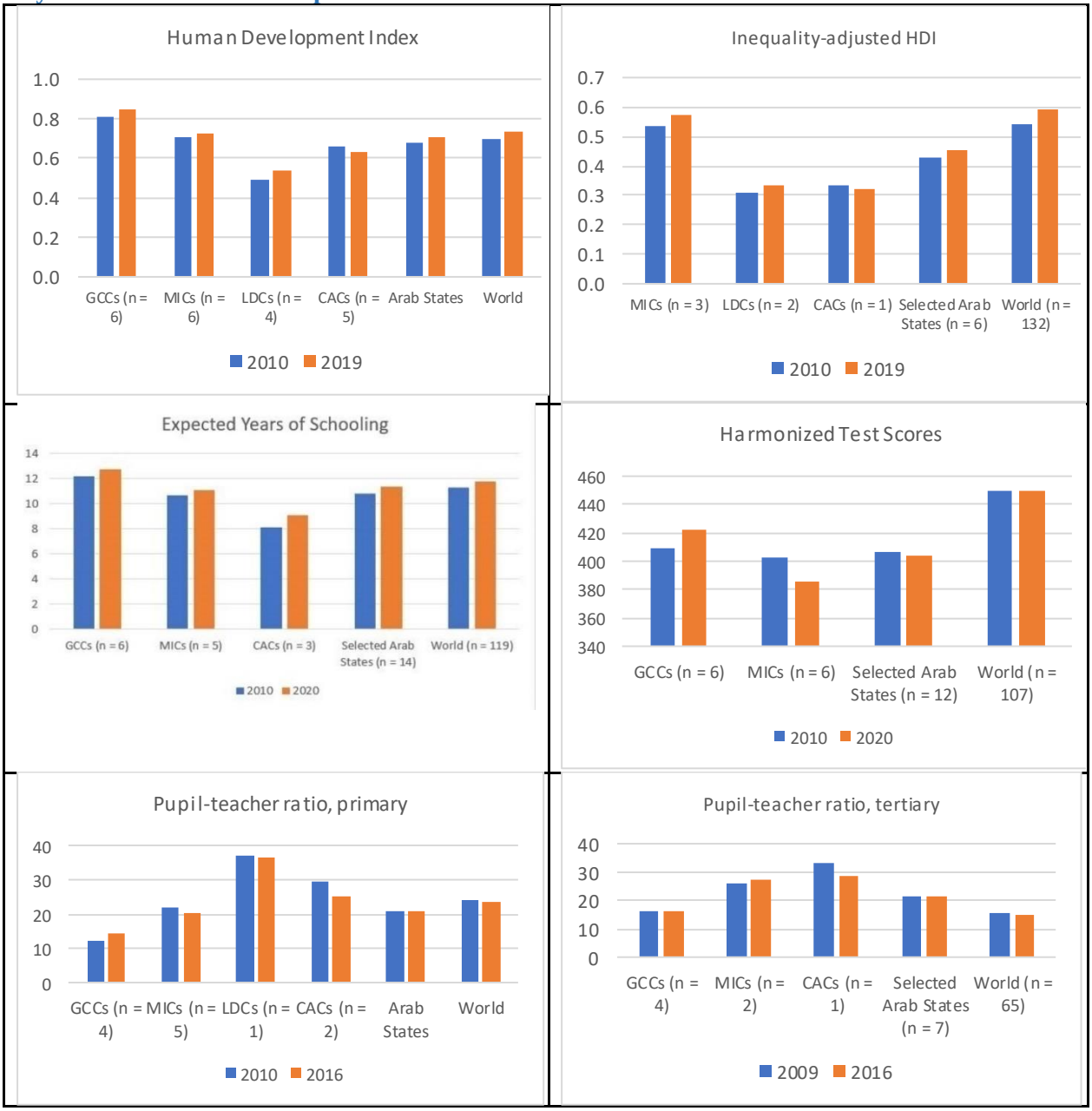
Zhang, Ning, Fanbin Kong, and Yanni Yu. "Measuring Ecological Total-Factor Energy Efficiency Incorporating Regional Heterogeneities in China." *Ecological Indicators*, Environmental issues in China: Monitoring, assessment and management, 51 (April 1, 2015): 165–72. https://doi.org/10.1016/j.ecolind.2014.07.041.

Zhou, P., B. W. Ang, and K. L. Poh. "Slacks-Based Efficiency Measures for Modeling Environmental Performance." *Ecological Economics* 60, no. 1 (November 1, 2006): 111–18. https://doi.org/10.1016/j.ecolecon.2005.12.001.

\

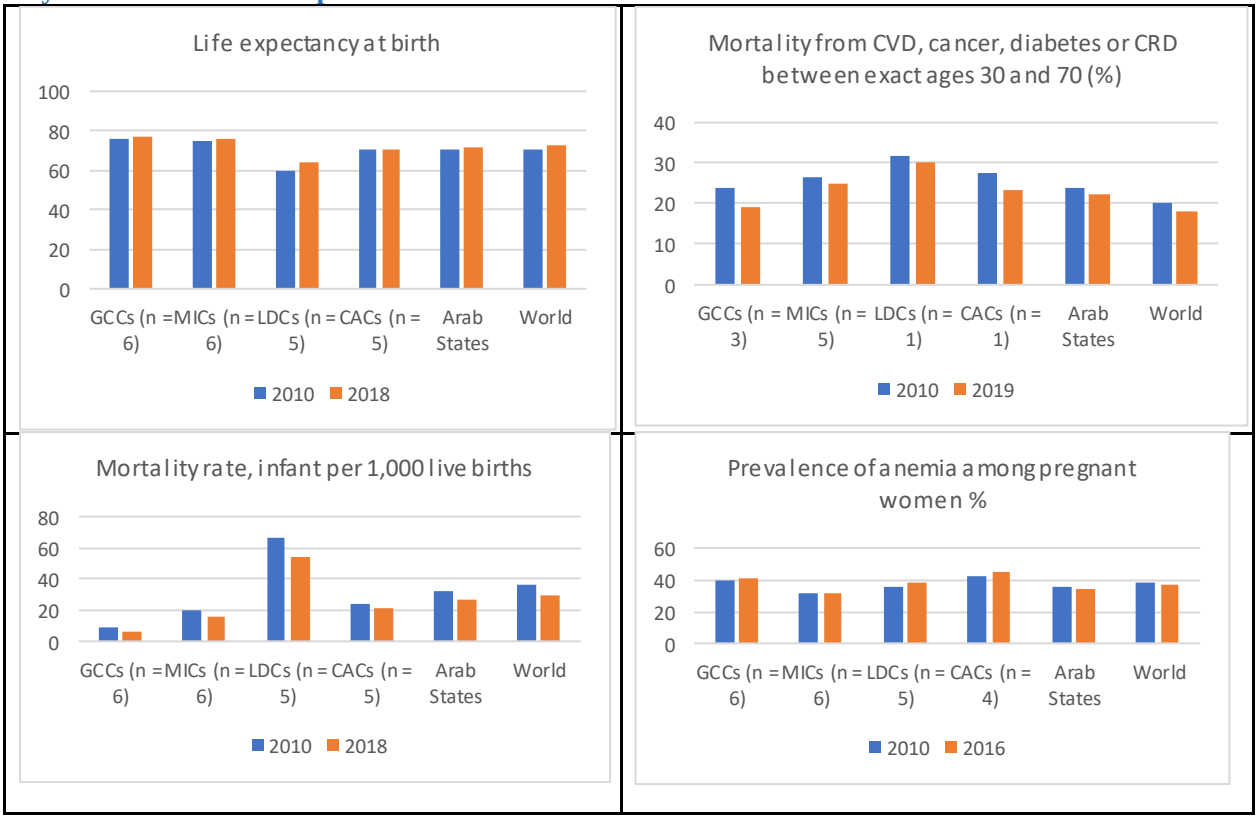
Annex 1

Key indicators of education performance in Arab States



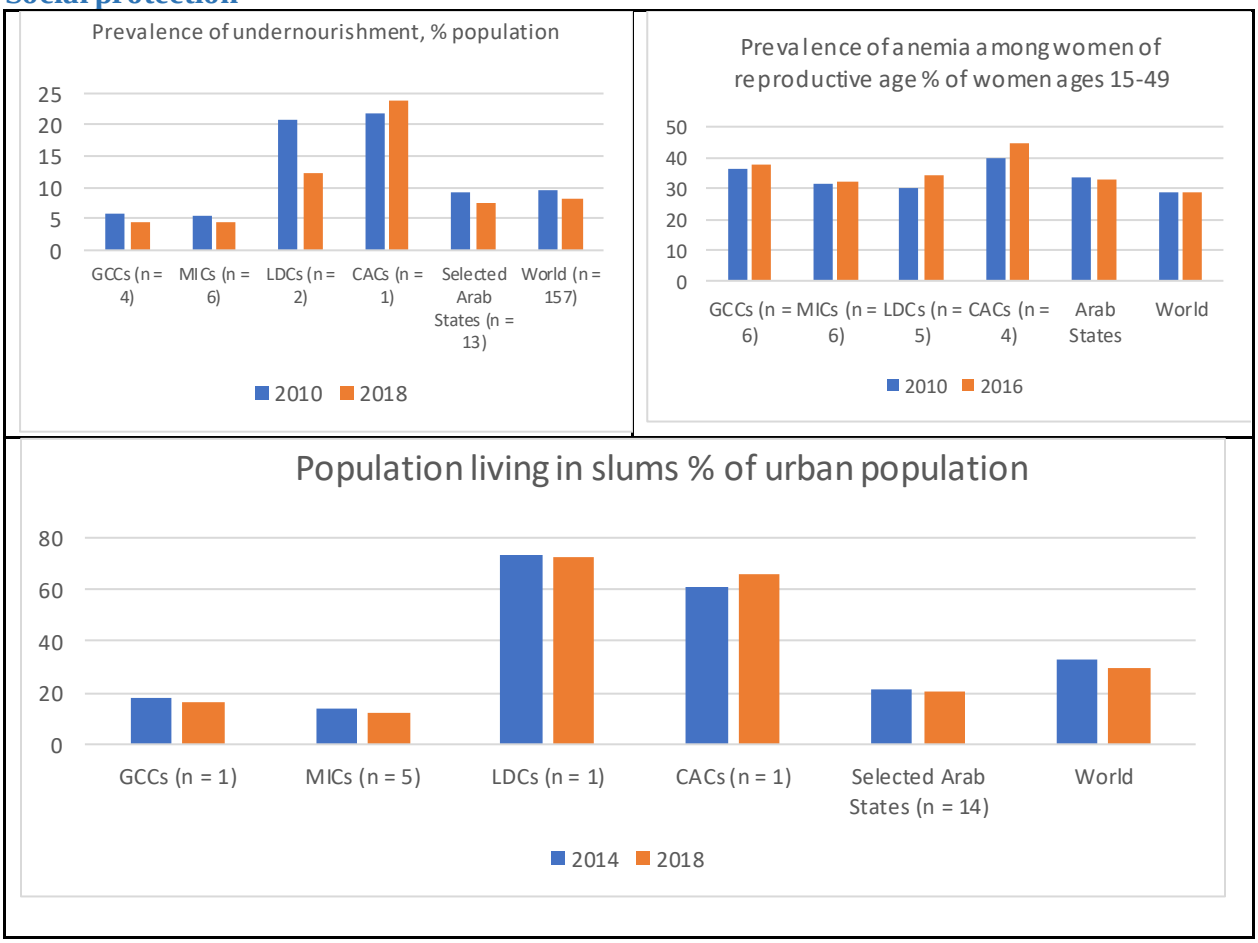
Annex 1 (cont')

Key indicators of health performance in Arab States



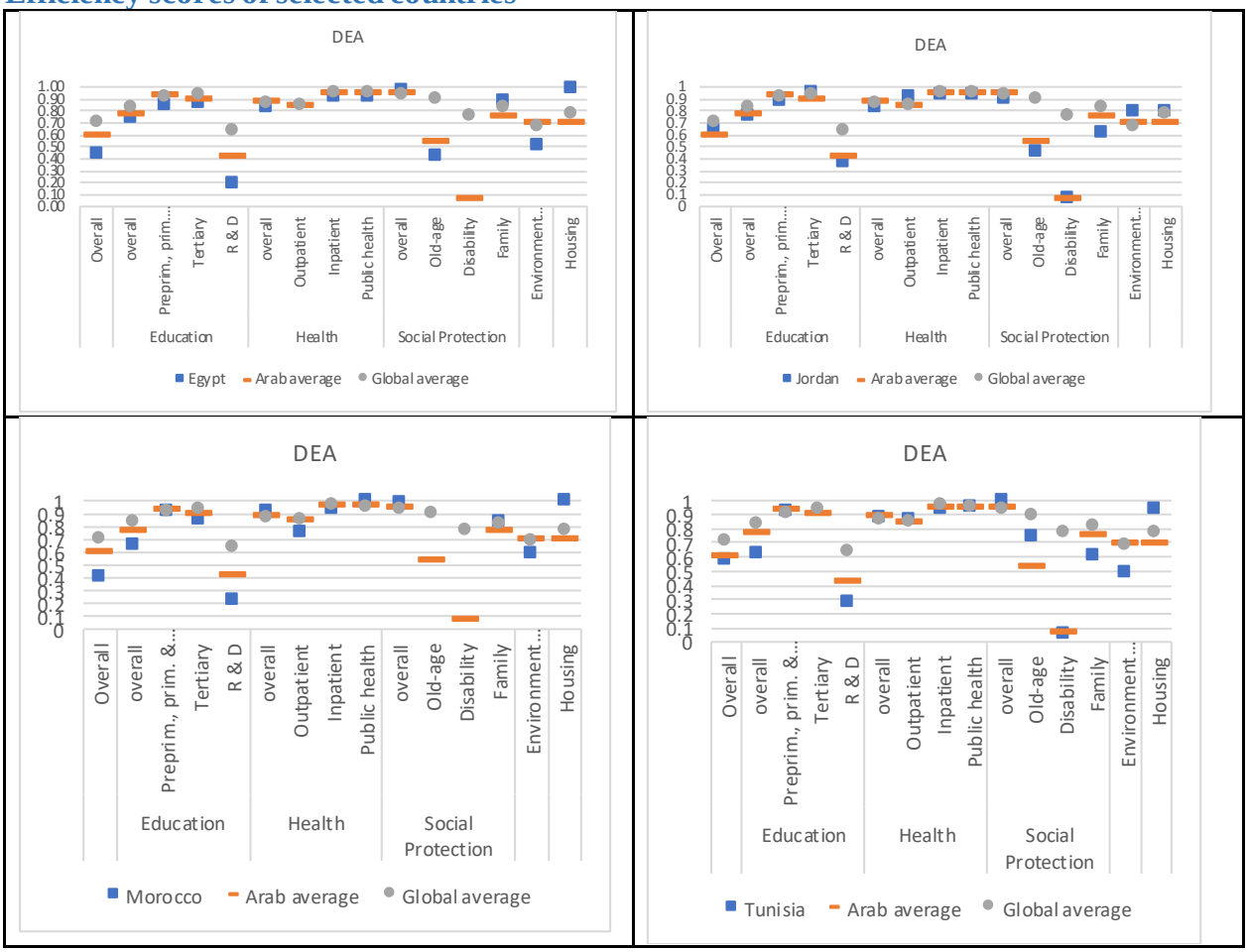
Annex 1 contd.

Social protection

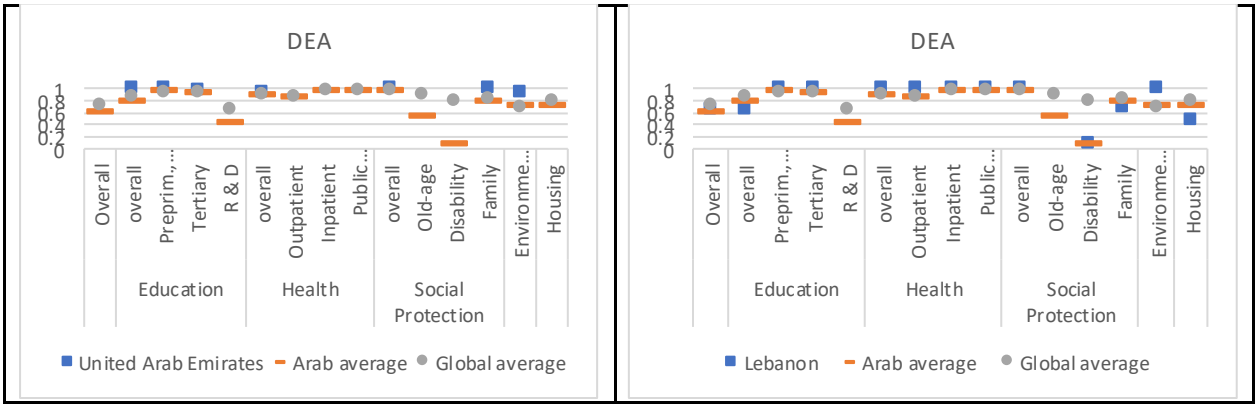


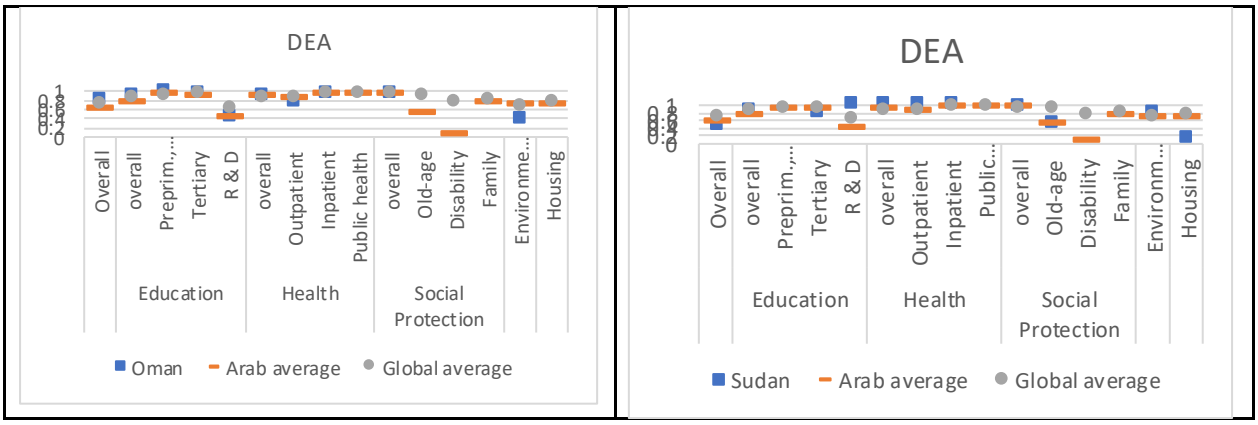
Annex 2

Efficiency scores of selected countries



Efficiency scores of selected countries




DEA
Overall
overall
Preprim.,...
Tertiary
R & D
overall
Outpatient
Inpatient
Public health
overall
Old-age
Disability
Family
Environme...
Housing
Education
Health
Social Protection
Oman
Arab average
Global average
DEA
Overall
overall
Preprim.,...
Tertiary
R & D
overall
Outpatient
Inpatient
Public...
overall
Old-age
Disability
Family
Environm...
Housing
Education
Health
Social Protection
Sudan
Arab average
Global average

Annex 3

Methodology of Efficiency analysis

Three methods to assess the efficiency of government expenditures are commonly used in the literature – Data Envelopment Analysis (DEA), Free Disposal Hull (FDH) and Stochastic Frontier Analysis (SFA). The former two are non-parametric methods, while in case of the last one parameters are estimated.

In the Data Envelopment Analysis, the productivity frontier is set by the most productive unit (decision-making unit, DMU). There are basically two variants – constant returns to scale as proposed by Charnes–Cooper–Rhode (Charnes et al. 1978) and variable returns to scale as described by Banker–Charnes–Cooper (BCC) (Banker et a. 1984). Both assume that the production set is convex and freely disposable. If we define the set of inputs of DMU_j as $(x_{1j}, \dots, x_{mj})$, the set of outputs as $(y_{1j}, \dots, y_{qj})$ for each DMU $j \in \{1 \dots n\}$and the set of weights as $(\lambda_1, \dots, \lambda_n)$ assume that both x_{rj} and y_{rj} are positive and let θ_j be the efficiency score of unit j.

1. The output oriented constant returns to scale model for DMU k has the following form

$$\max_{\lambda} \theta_k$$

Subject to

$$\begin{cases} \sum_{i=1}^{n} \lambda_i x_{ji} \leq x_{jk} \; for \; j = 1, \dots, m \\ \sum_{i=1}^{n} \lambda_i y_{ji} \geq \theta_k y_{jk} \; for \; j = 1, \dots, q \\ \lambda_j \geq 0 \; for \; j = 1, \dots, n \end{cases}$$

   The efficiency score for unit k is therefore θ_k. $\theta_k$is equal to one for the most efficient unit and other units have values greater than one, reflecting the fact that higher output could be achieved if they were more efficient..

2. The input oriented constant returns to scale model has the following form

$$\min_{\lambda} \theta_k$$

   Subject to:

$$\begin{cases} \sum_{i=1}^{n} \lambda_i x_{ji} \leq \theta_k x_{jk} \ for\ j = 1, \dots, m \\ \sum_{i=1}^{n} \lambda_i y_{ji} \geq y_{jk}\ for\ j = 1, \dots, q \\ \lambda_j \geq 0\ for\ j = 1, \dots, n \end{cases}$$

The efficiency score for unit k is again θ_k. θ_k is equal to one for the most efficient unit and have values smaller than one reflecting the fact that less resources could be employed to receive the same output.

3. In case of variable returns to scale, the constraint that all weights must add up to one is added, so we have the following optimization problem for output-oriented VRS DEA:

$$\max_{\lambda} \theta_k$$

Subject to

$$\begin{cases} \sum_{i=1}^{n} \lambda_i x_{ji} \leq x_{jk}\ for\ j = 1, \dots, m \\ \sum_{i=1}^{n} \lambda_i y_{ji} \geq \theta_k y_{jk}\ for\ j = 1, \dots, q \\ \lambda_j \geq 0\ for\ j = 1, \dots, n \\ \sum_{j=1}^{n} \lambda_j = 1 \end{cases}$$

4. And for the input oriented, the formulation is analogous:

$$\min_{\lambda} \theta_k$$

Subject to

$$\begin{cases} \sum_{i=1}^{n} \lambda_i x_{ji} \leq \theta_k x_{jk} \ for\ j = 1, \dots, m \\ \sum_{i=1}^{n} \lambda_i y_{ji} \geq y_{jk}\ for\ j = 1, \dots, q \\ \lambda_j \geq 0\ for\ j = 1, \dots, n \\ \sum_{j=1}^{n} \lambda_j = 1 \end{cases}$$

It is easy to note that in trivial one input one-output DEA model with constant returns to scale, the productivity frontier is just the most favorable relationship between input and output.

Another non-parametric method, frequently used in efficiency analysis is Free Disposal Hull (FDH). In contrary to DEA, in case of FDH the convexity assumption is relaxed and relies on observed relations between input-output bundles. However, it is the same optimization problem as DEA with variable returns to scale, but with additional constraint that λ_j must be equal either to

zero or one, formally $\lambda_j \in \{0,1\}$. It can be also either input or output oriented. The differences between the productivity frontiers generated by each method are presented on figure 2. The comprehensive comparisons of the non-parametric methods of efficiency calculations can be found in Wang et al. (2003) or Ward (2003).

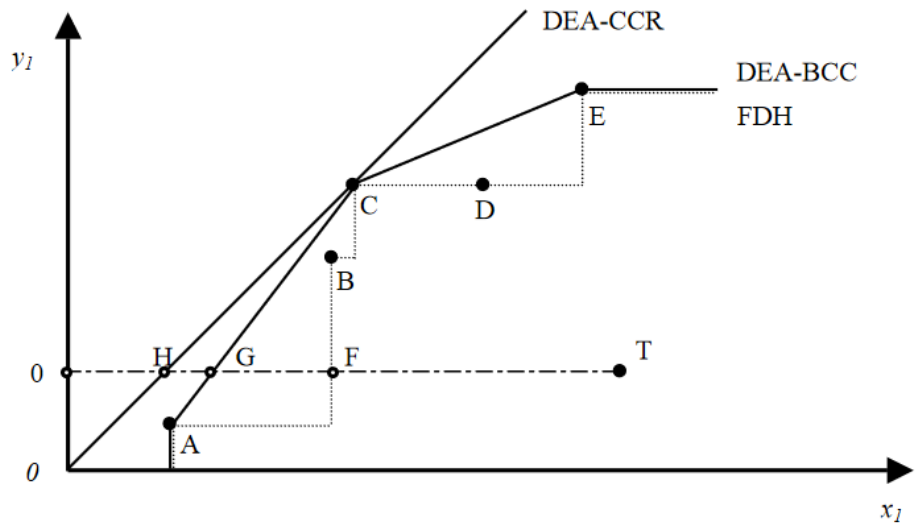


Figure. The productivity frontiers in one-input, one-output case in two variants of DEA and FDH.
Source: Wang et al. (2003)

In contrary to the above, stochastic frontier analysis is parametric method in which functional relationship between inputs and outputs is assumed. Consequently, we have the following production function (one output is allowed in this case:

$$y_i = f(x_{ik}\beta)TE_i \exp(\epsilon_i)$$

Where TE_i is technical efficiency. It is assumed to be stochastic variable with the distribution that is common across all producers. If $0 \leq TE_i \leq 1$, than it is usually replaced by the $\exp(-u_i)$, where $u_i \geq 0$. Consequently, the model can be written as:

$$y_i = f(x_{ik}\beta)\exp(-u_i)\exp(\epsilon_i)$$

With Cobb-Douglas production function and logging the production function, one obtain:

$$\ln y_i = \beta_0 + \sum_{j=1}^{m} \beta_j x_{ij} - u_i + \epsilon_i$$

In this case ϵ_i is noise component that is used exactly like in any regression model and $u_i$is non-negative technical inefficiency component. Together they are sometimes referred to the compound model. Technical efficiency is calculated and presented as $\exp(-u_i)$. Usually u_i has truncated normal, half normal, exponential or gamma distribution and the model is fit using the maximum likelihood method. Furthermore, the mean in the truncated normal distribution u_i may depend on control variables – we use this possibility to take into account the impact of exogenous variables on efficiency score.

These controls variables are inflation, government effectiveness, domestic credit to private sector (% of GDP), GDP per capita USD PPP, fertility rate and urbanization rate. Using these controls is, in principle, responsible for the higher efficiency scores while using the stochastic frontier method – in case of DEA, the efficiency scores in terms of input are affected also by the factors that are captured by the control variables. For each of the variables, three years moving average was used with newest available observation that equals to 2017-2019 average. Also, for data comparability, cross-section efficiency based on global sample was estimated.

Decomposition of efficiency

Estimating the efficiency within each subcategory constitutes significant value added as such, because it shows policy makers where there is a some scope for improvement and where efforts to improve efficiency should be focused. However, we can also use these estimates to decompose the overall efficiency to suggest what should be improved to boost overall education, health or social protection results.

We can decompose the total efficiency for given area of interest and country as follows:

$$E = \frac{Y}{C} = \frac{\prod_{i\in I} {Y_i}^{\alpha_i}}{C} = \prod_{i\in I} \frac{{Y_i}^{\alpha_i}}{{C_i}^{\alpha_i}} \frac{{C_i}^{\alpha_i}}{C^{\alpha_i}} C^{\alpha_i - 1} = C^{\sum_{i\in I}\alpha_i - i} \prod_{i\in I} {E_i}^{\alpha_i} {\delta_i}^{\alpha_i} \quad (1)$$

And logged:

$$logE = \left(\sum_{i\in I} \alpha_i - i\right) logC + \sum_{i\in I} \alpha_i \left(logE_i + log\delta_i\right) + \varepsilon \quad (2)$$

Where Y is the total – aggregate output, $C = \sum_{i\in I} C_i$ is the total cost, $E = \frac{Y}{C}$ is aggregate efficiency, Y_i is the output in category i, C_i is the amount of money devoted to achieve this output, $E_i = \frac{Y_i}{C_i}$ is the efficiency of expenditures in that category and $\delta_i = \frac{C_i}{C}$ is the share of expenditures for that category in total outlays. If we can estimate the *elasticity* coefficients α_i, we may show which subcategories of output should be improved first as they have the most significant influence on the overall efficiency. Also, we can show how efficiency changed in time:

$$\Delta logE = \left(\sum_{i \in I} \alpha_i - i\right) \Delta logC + \sum_{i \in I} \alpha_i \left(\Delta logE_i + \Delta log\delta_i\right) + \Delta\varepsilon \quad (3)$$

So we have:

- Change in efficiency of given component: $\alpha_i \Delta logE_i$;
- Change in structure: $\sum_{i \in I} \alpha_i \Delta log\delta_i$;
- Residual: $(\sum_{i \in I} \alpha_i - i)\Delta logC + \Delta\varepsilon$.

Within this paper, we present the following decomposition:

- Overall efficiency to education, health, social protection, housing and environmental protection components;
- Education efficiency to pre-primary, primary and secondary efficiency, tertiary efficiency and education R&D efficiency;
- Health efficiency to inpatient efficiency, outpatient efficiency, public health efficiency and health R&D.