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Efficiency of Public Health Expenditures in GCC: A focus on Kuwait

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Abstract

This paper follows the frame work of (Afonso and Aubyn ,2004), aiming to assess the efficiency of health spending in GCC countries with a focus on Kuwait during 2000-2017. This area where public expenditure is for great importance so that finding have strong implications in what concerns public spending efficiency. This will be of great importance for all GCC countries especially Kuwait after being affected by double shock covid-19 outbreak and lower oil prices which put more pressure on its fiscal position and force the government to rethink to pass new debt law allowing Kuwait to access the global debt capital markets and diversify its funding options. The paper tries to measure efficiency of public spending in health in Kuwait during 2000-2017 by applying two non-parametric methodologies: Free Disposal Hull and Data Envelopment Analysis. The empirical results show that **on average**, public spending in health sector is inefficient, which means that performance in this sector can be enhanced without increasing expenditure. For example, it was found that in the health sector the outcomes can be increased by 35% without spending more resources, also it was found that the same results can be achieved by reducing public spending by 23%.

كفاءة الانفاق العام على الصحة في دول مجلس التعاون الخليجي: بالتركيز على دولة الكويت

أماني عبدالوهاب

ملخص

تعتمد هذه الورقة على المنهجية المستخدمة في ورقة عمل (Afonso and Aubyn ,2004)، وذلك بهدف تقييم كفاءة الإنفاق الصحي في دول مجلس التعاون الخليجي مع التركيز على دولة الكويت خلال الفترة الزمنية 2000-2017. يعتبر ترشيد الإنفاق العام في القطاع الصحي أمراً بالغ الأهمية حيث أن ترشيد و زيادة كفاءة الإنفاق العام في قطاع الصحة ستدعم بالتأكيد كفاءة الانفاق العام ككل وخاصة في ظل الصدمة المزدوجة المتمثلة في تفشي فيروس كورونا وانخفاض أسعار النفط التي يعيشها دول مجلس التعاون الخليجي وخاصة الكويت مما زاد الضغط على المالية العامة مما دفع الحكومة على إعادة التفكير في تمرير قانون للدين العام مما يسمح للكويت الوصول إلى أسواق رأس المال العالمية وتنويع خيارات التمويل الخاصة بها.يهدف البحث إلي قياس كفاءة الإنفاق العـــام في مجـــال الصحة في الكويت خلال الفترة 2000-2017 من خلال تطبيق منهجيتين غيـر بارامتريـــة Free Disposal Hull & Data Envelopment Analysis. أظهرت النتائج التجريبية أنه في المتوسط، يعتبر الإنفاق العام في قطاع الصحة غير كفء، مما يعني أنه يمكن تحسين الأداء في هذا القطاع دون زيادة الإنفاق. على سبيل المثال، وجد أنه في قطاع الصحة يمكن زيادة النتائج بنسبة 35% دون إنفاق المزيد من الموارد، كما وجد أنه يمكن تحقيق نفس النتائج عن طريق خفض الإنفاق العام بنسبة 23.%

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1. Introduction

One of the key instruments through which the state implements its development goals is fiscal policy. The expenditures help in executing different tasks, varies from providing public services, paying for wages and transportation infrastructure. The choice of the level and composition of government expenditures and its financing affect economic growth through the impact on investment, infrastructure, and human development. The expenditures provide an indication for the government size and they are usually less flexible than government revenues, they are also sensitive to the economic cycle (OECD,2011).

The study measures public spending efficiency in Kuwait with more recent data hence marking an advance. The study is not focusing on how to reduce public expenditures, but rather more on increasing the efficiency and effectiveness of the money spent by the Kuwaiti government. The focus will be on health sector and its spending efficiency for its great impact on the Kuwait's economic development and SDGs specially goal 3 that "ensure health lives and promoting the well-being at all ages". The study is trying to answer if Kuwait can obtain better performance results in health sector using the same resources. There is a need to improve public spending efficiency to be in line with Kuwait 2035 vision and its related programs, which in turn will stimulate economic growth and promote growth of the private sector.

The paper is set out as follow. Next section provides a brief explanation of public spending efficiency concept and its determinants; then a literature review about measuring public spending efficiency. Section 2 provides stylized facts. section 3 describes the data and methodology of measuring efficiency. Section 4 summarizes the results and policy recommendations.

2. Literature review

Public spending is an important engine of the economic growth and human development as mentioned by (Lucas,1988) as when the government increases spending on education& health, the level of human capital will rise which in turn leads to high economic growth.

The literature differentiates between productive or more growth oriented expenditure from unproductive one. Productive expenditure is defined by comparing outputs produced, or objectives achieved, with given expenditures, it

includes public infrastructure investments, education & training and health**.** The unproductive expenditure may be defined as the difference between the actual public spending on the program and the reduced spending that would yield the same social benefit with maximum cost-effectiveness (IMF,1995).

The government efficiency, can be defined as the capability of the government to invest its public resources in order to produce public goods and services which benefit the majority in the economy and promote economic growth. Better quality of institutions ensures more effective government which allocates public resources more efficiently and spur economic growth. (Alfonso, Schuknecht and Tanzi ,2006)

Another efficiency definition is introduced by (Farrell ,1957) that showed the relationships between inputs, outputs and outcomes. Any economic sector can be expected to increase its output by simply increasing its efficiency, without adding further resources. The measurement of efficiency of public spending remains a challenge because public spending has different objectives, public sector outputs are not sold on the market, the price data is not available and that the output cannot be quantified.

The level and the composition of expenditures are not informative of their efficiency in translating public resources into desired outcomes. For example, large spending on health does not automatically guarantee achieving high health outcomes. In this case, other performance indicators should be checked to assess the effect of spending on the quality of health. So small changes in the efficiency of public spending could have a significant impact on GDP and on the attainment of the government's objectives.

The government spending efficiency can be determined by the following:

- **The size and the composition of government expenditure:** according to different studies, there are mixed results, some have found negative relation between efficiency and the size of the government expenditure. Also the composition of government budget is an important factor in determining the efficiency of the public spending. One of the efficiency indicators is the ratio of wage bill to the total budget. A high ratio indicates inefficiency which is the case in the Kuwaiti economy.
- **Quality of fiscal institutions**: it is considered to be determinant of fiscal policy cyclicality. The institutional problems affect the effectiveness of the

government expenditures. The low institutional quality leads to a more procyclical government expenditures that hinder economic growth. (Garayeva and Tahirova,2016).

- **Quality of government planners** is essential for the maximization of government efficiency thereby economic growth. (Shen et. al. 2015) ensured that the government planners should be able to foresee future economic conditions prior to the implementation of any public expenditure policy and injection of public funds. Planners must be capable of minimizing errors when they select public projects which will be financed during a particular fiscal year.
- **Good governance**: is the core issues to be in place to ensure maximum efficiency that boosts the impact of government expenditure on economic growth. A 1%-point increase in the share of public health spending to GDP lowers the under 5 mortality rate by 0.32% in countries with good governance (as measured by corruption index) and by 0.20% in countries with average governance; while an increase in spending has no impact in countries with weak governance (Kim & Wang ,2019).

(Afononso, , Aubyn & Miguel, 2005) addressed the efficiency in education and health sectors for **a sample of OECD** countries by applying Free disposal hull (FDH)and Data Envelopment analysis (DEA), about three countries appeared to be efficient regardless the sector or the methodology used as Korea, Japan and Sweden. Japan is the best performer in education and one of the best in health and it doesn't spend too many resources. Korea is a very good education performer, and it spends little on health but with a very good outcome.

(Alfonso& Kazem,i 2016) assessed the public spending efficiency in 20 **OECD countries** during the period 2009-2013.They constructed the composite indicators on Public Sector Performance (PSP), Computed the Public Sector Efficiency (PSE), and a non-parametric approach called Data Envelopment Analysis (DEA) for 6 different model is applied. The results showed that the only country that performed on the efficiency frontier is Switzerland. On average countries could have reduced the level of public expenditure by 26.8% and still achieved the same level of public performance. The average output-oriented efficiency score is 0.769 denoting that on average the sample countries could have increased their performance by 23.1% by employing the same level of public expenditure.

(ERF, 2015) assessed the public spending efficiency of selected **MENA countries** that have recently experienced political changes to know how such economic and political changes effect public spending efficiency. the study analyzed the impact of governance, political and economic policies on public

expenditure efficiency across these countries using Data Envelopment analysis and Topin regression analysis for the period 1996-2011. The results show that more political stability is positively related to public spending. More political freedom has negative impact on the efficiency of public spending on education and infrastructure. trade freedom and economic growth are positively related to the efficiency of public spending. Jordon is relatively more efficient in public spending on administration, education and health. while Tunisia is the most efficient in public spending on infrastructure. Libya, Algeria and Yemen are relatively less efficient in public spending. Djibouti spends the highest percentage of government expenditure on education, but it presents a lower level of enrollment in secondary education.it spends significant amount on health but it has lower life expectancy at birth. In Jordan and Tunisia, enrollment in secondary education is high. Jordan has the highest % of government expenditure on health and has the highest life expectancy at birth in the MENA region.

For the country level analysis, study done by (Ouertani et. al. 2018) to measure the relative efficiency of **Saudi Arabia's** public spending over the period 1988–2013 using non-parametric approach and explain the inefficiency scores using a DEA-Bootstrap analysis(1) by incorporating environmental variables. The empirical results showed that on average, the public spending is inefficient, implying that Saudi Arabia can improve their performance on health, education and infrastructure without increasing spending. For the education sector, the government expenditure was only efficient in 2013. Policy makers can improve the level of education by saving 49.7% of the amount of inputs used. Health government expenditures was inefficient for all the time period. For the infrastructure sector, Government spending was inefficient and infrastructure outcomes can be enhanced by about 16% without spending more resources, but it was higher than education spending efficiency.

In the united Arab of emirates, (IMF 2014) reviewed the efficiency of spending based on survey based indicators on health and education outcomes. According to different aspects, spending in the UAE is considered to be effective and efficient, as it controls corruption and avoid wasteful spending. Data suggests that education spending is efficient in producing educational outcomes compared to the amount spent (very low). For the health, the government spending is higher but less efficient compared with other countries. For the infrastructure, the UAE achieved the highest rank in term of the quality (at reasonable cost also). Data envelopment analysis and free disposable hull analyses suggest that UAE is among the most efficient countries in the region in public investment, however there is a lot to do specially in public investment management.

(Hauner, 2007) benchmarked the efficiency of public expenditure in the social sectors (health, education, and social protection) in the **Russian Federation** relative to other countries and among the country's regions at the general and local government levels. The efficiency in education seems to be relatively high, the current outcomes in health and social protection could be produced with only about two-thirds of the present spending. At the local government level, comparing spending and outcomes across regions suggests that, on average, the current outcomes in health, education, and social protection could again be produced with about two-thirds of the present inputs if the less efficient regions would imitate the more efficient ones.

In summary, most of the studies that concerned with measuring public spending efficiency, they relate government expenditure to socio-economic indicators that are assumed to be targeted by public spending, such as education enrolment ratios or infant mortality; the results of cross-country examinations suggest that there are substantial efficiency differences between countries, irrespective of their income level. On average, the spending of emerging countries towards education, health and infrastructure are inefficient especially for the countries with higher expenditure levels. The relationship between efficiency scores and public expenditure is negative, implying that health output requires efficiency improvement more than increased budgetary allocations.

1. Health expenditures in the GCC countries with focus on Kuwait

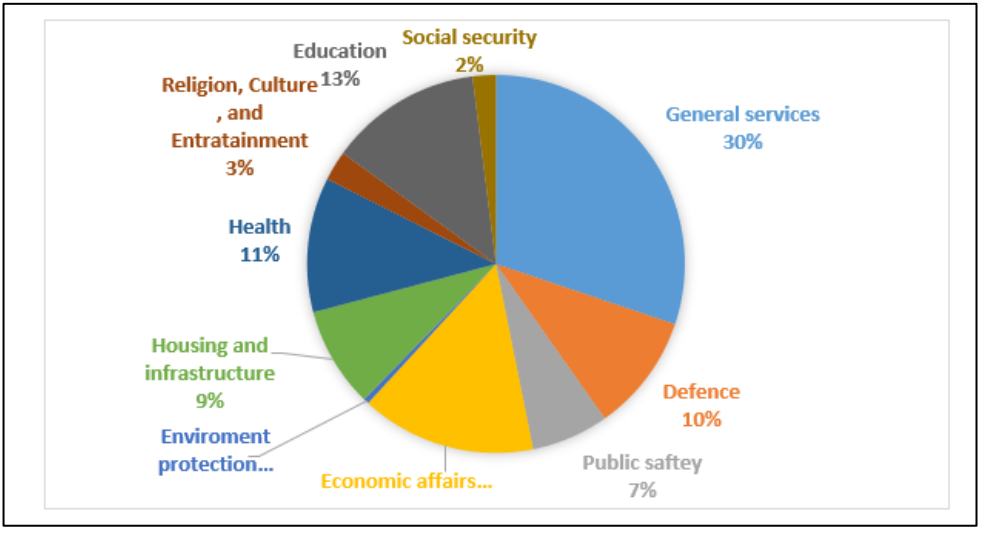
In order to assess the quality of public expenditures, review of the composition of public expenditure should be undertaken along with the analysis of the efficiency of expenditure within each category.

Several aspects of the fiscal policy in Kuwait and other GCC are connected to oil as the oil based growth creates its own economic and social challenges. There has been rapid increase of government expenditure on health services on the level of GCC countries but it remains below 10% global average. The UK spends 9.3% GDP, USA spends 16.2% (Dhaoui,2015).

In Kuwait, the health accounts for around 11% of public expenditures in year 2018, compared to 8.9% in 2017 (Figure 1), for other GCC the ratio is 10.1% in Saudi Arabia, 6.3% in Qatar, 7.9% in United Arab of Emirates and in Bahrain 8.5%. For the public health expenditures as % GDP it ranges from 2.4% in UAE to 4.6% in Kuwait (Table 1). For the out of the pocket expenses on health care it is

considered to be high in the GCC as it is ranging from 6.7% of GDP in Oman to 30.6% in Bahrain in year 2017(Dhaoui,2019).

Figure (1): Expenditure by function 2018/2019



Source: Ministry of Finance – Kuwait

Table (1): Public Health expenditures as % GDP in GCC

	2005	2011	2017
Kuwait	1.9	2.3	4.6
Saudi Arabia	2.5	2.5	3.4
United Arab Emirates	1.3	2.7	2.4
Bahrain	2.1	2.2	2.8
Qatar	1.9	1.2	2.1
Oman	2.1	2.1	3.4

Source: WHO, https://apps.who.int/nha/database/country_profile/Index/en

GCC governments pay on average for 70% of all healthcare bills and private-sector payers and providers remain relatively small, which means that the governments are the key player in the health sector (Table 2).[(2)]

Table (2): Current Number of GCC health care providers

		KSA	**UAE**	**Kuwait**	**Qatar**	**Oman**	**Bahrain**
Health care providers	Total	5540	3323	813	276	1445	445
hospitals	**Total**	**470**	**126**	**30**	**12**	**74**	**26**
	Govt	318	38	18	8	55	8
	Pvt	152	88	12	4	19	18
Primary health care centers	**Total**	**2325**	**150**	**96**	**24**	**266**	**124**
	Govt	2325	150	96	24	266	124
	Pvt	-	-	-	-	-	-
clinics	**Total**	**2745**	**3047**	**687**	**240**	**1105**	**295**
	Govt	-	120	337	-	-	-
	Pvt	2754	2927	350	240	1105	295

Source: Kuwait life science, GCC health report 2018

The overall access to medical care has improved in the GCC, but some gaps remain. Attracting and retaining medical staff is difficult. The UK has 8.4 nurses per 1,000 inhabitants, and the US 9.9 compared with just 3.1 nurses per 1,000 inhabitants of the United Arab Emirates, and 5.2 in the Kingdom of Saudi Arabia and 5.6 in Kuwait (Table3) [(3)].

Table (3): GCC Health indicators ,2018

GCC health indicators per 000s population in 2018	**KSA**	**UAE**	**Kuwait**	**Oman**	**Qatar**	**Bahrain**	**Gcc Average**
Beds	2.2	1.2	2.0	1.5	1	1.9	1.6
Physicians	2.8	1.7	2.3	1.5	2.1	2.6	2.1
Nurses	5.7	3.4	5.6	4	4.9	4.7	4.6
Pharmacist	0.8	0.6	0.6	0.6	0.5	0.6	0.6
Allied health professionals	3.4	2.7	2.7	2.5	2.9	2.0	2.5

Source: Kuwait life science, GCC health report 2018

For the cost of health sector, it seems to be high in the GCC as the estimated spending on medical travel in the GCC can reach $20 billion a year which put the government budgets under pressure during oil shocks while demand for healthcare continues to rise, driven by population growth, aging populations and increasing prevalence of chronic diseases and spread of pandemic. (4)

The achieved outcomes of the health sector are low compared with spending in the GCC and it is below that of equivalent health systems in other regions, that is why the governments usually send many patients abroad for treatment of complex cases due to lack of specialized services. This can be contributed to several factors as inadequate infrastructure, lack of high Technology, capacity of staff, poor governance and control of corruption as these factors are essentials in improving health outcomes. The health system needs to decrease their unit costs and improve their quality level. When the health expenditure efficiency increases the level of outputs will also increase as the increase in life expectancy at birth, decreasing infant and maternal mortality (Dhaoui,2019).

3- Empirical methodology and data description

3.1 Empirical Methodology

In order to assess the efficiency of public expenditures, the review of the composition of public expenditures that is done in the previous section should be complemented by an analysis of the efficiency of expenditure within each category.

The main goal is to measure efficiency of the public health spending in Kuwait. When measuring efficiency, a distinction can be made between technical and allocative efficiency.

Technical efficiency measures the pure relation between inputs and outputs taking the production possibility frontier into account. “Technical efficiency gains are a movement towards this production possibility frontier” (“best practice”). (Mandl, et al., 2008) . However, the Allocative efficiency reflects the link between the optimal combination of inputs taking into consideration the costs and benefits and the output achieved. A maximum allocative efficiency can be achieved using an optimal combination of inputs. Thus, the measurement of allocative efficiency requires needs an in-depth analysis of the area in question as well as information on the broad country-specific strategies and most notably information on input prices (Mandl, et al., 2008). In this research we are interested with Technical efficiency.

The most widely methods to measure efficiency can be classified into parametric or non-parametric. The parametric approach assumes a well specified functional form for the relationship between the inputs and the outputs. The nonparametric approach calculates the frontier directly from the data without imposing specific functional restrictions. Econometric methods are used for parametric methods, while the second one uses mathematical programming techniques. Also, methods can be classified into deterministic and stochastic approaches. The deterministic approach considers that the inefficiency is explained by all deviations from the frontier, while the stochastic approach considers those deviations a combination of inefficiency and random shocks outside the control of the decision maker. (Herrera & Ouedraogo, 2018)

The paper uses non-parametric methods to avoid assuming specific functional forms for the relationship between inputs and outputs or for the inefficiency terms. Data envelopment analysis (DEA) and free disposal hull (FDH) analysis are alternative nonparametric techniques for constructing production and related frontiers, and for measuring the performance of production units relative to those frontiers. (Lovell& Eeckaut, 1993). The following is the description of the two methods:

Data envelopment analysis

Data envelopment analysis (DEA) is a linear programming-based technique for measuring the relative performance of organizational units when having multiple inputs and outputs. Having multiple outputs and multiple inputs makes the comparisons difficult. The main assumption of the DEA is that there is linear combinations of the observed input-output bundles are feasible. (Herrera & Ouedraogo, 2018)

(Charnes, et .al. 1978) recognized the difficulty in seeking a common set of weights to determine relative efficiency. They recognized the legitimacy of the proposal that values of inputs and outputs for each unit may be different and therefore adopt different weights, and proposed that each unit should be allowed to adopt a set of weights which shows it in the most favorable light in comparison to the other units. Under these circumstances, efficiency of a target unit j_0 can be obtained as a solution to the following problem:

Maximize the efficiency of unit j_0,

subject to the efficiency of all units being < =1.

The variables of the above problem are the weights. The solution produces the weights most favorable to unit j_0 and also produces a measure of efficiency.

The algebraic model is as follows:

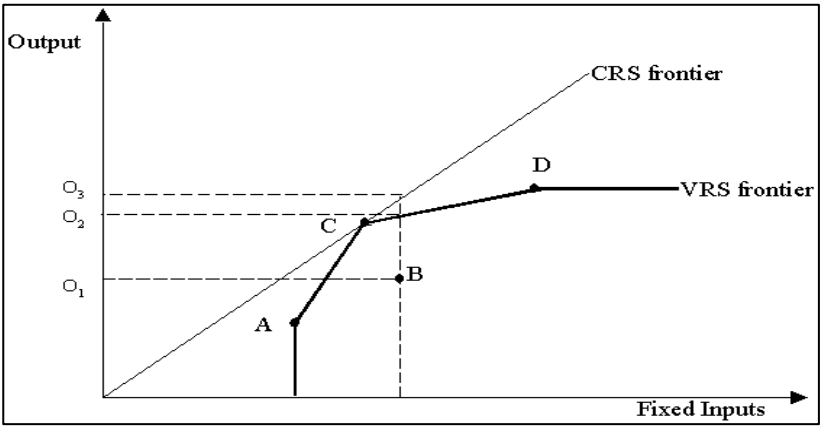
$$\left.\begin{aligned} &\text{Max } h_0 = \frac{\sum_r u_r y_{rj_0}}{\sum_i v_i x_{ij_0}} \\ &\text{subject to} \\ &\frac{\sum_r u_r y_{rj}}{\sum_i v_i x_{ij}} \le 1 \quad \text{for each unit j.} \\ &u_r \,,\, v_i \ge \varepsilon \end{aligned}\right\}$$

Source: Charens A., Cooper W. and Rhodes E. (1978). Measuring the efficiency of decision making units, *Eur. J. Opl. Res 2*, 429-444.

The u's and v's are variables of the problem and are constrained to be greater than or equal to some small positive quantity ε in order to avoid any input (x_{ij}) or output (y_{rj}) being totally ignored in determining the efficiency. The solution to the above model gives a value h_0, the efficiency of each unit, and the weights leading to that efficiency. If $h_0 = 1$ then this unit is efficient relative to the others but if h_0 turns out to be less than l, then some other units are more efficient than this unit.

Figure (2) illustrates the single input single output DEA production possibility frontier. DEA frontier is a linear function that connecting all the efficient decision-making units (DMU). The piecewise linearity is used to display the feasibility assumption. It can be concluded that DMU's A, C, and D are efficient using the definition of DEA frontier, while the DMU B is not efficient as it is lying below the variable returns to scale (VRS, further defined below) efficiency frontier.

Figure (2): DEA production possibility frontier



Both ***constant returns to scale (CRS), and*** **Variable returns to scale (VRS)** are type of frontier scale used in *data envelopment analysis (DEA)*. If output increases by the same proportion as all inputs change; then there are ***constant returns to scale (CRS).*** However, the **Variable returns to scale (VRS)** helps to estimate efficiencies whether an increase or decrease in input or outputs does not result in a proportional change in the outputs or inputs respectively (Cooper, et al., 2011).

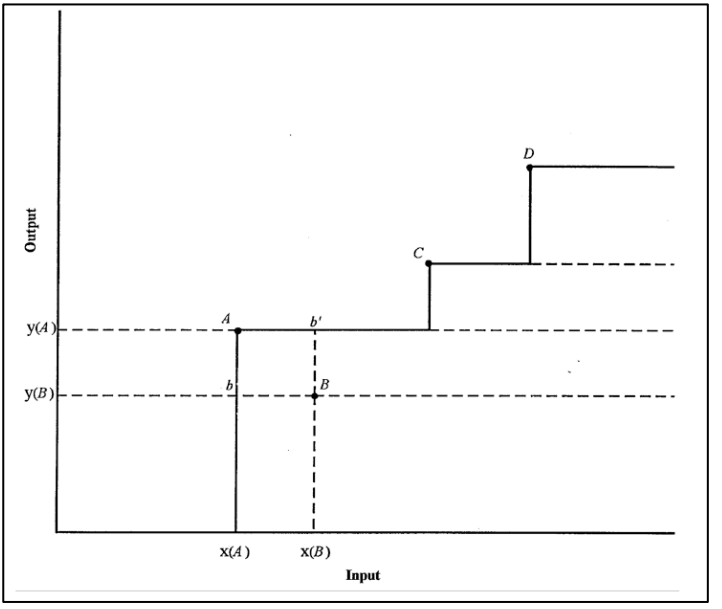
Free disposal Hull (FDH)

The FDH model was introduced and developed from the discussions in the field of production economics by (Deprins, Simar, and Tulkens ,1984), (Cherchye and Post ,2000). The main assumption of the Free Disposal Hull model is relaxing the convexity in defining the production possibility set from the observations. Free disposability means if a specific pair of input and output is producible, then combining any different pairs with more input and less output for the specific one is also producible. Using FDH the free disposability is allowed to be constructed by the production possibility set. Accordingly, the frontier line for FDH model is developed from the observed inputs and outputs allowing the free disposability. (Herrera & Ouedraogo, 2018)So, FDH is considered as an alternative approach to DEA for efficiency measurement.

Figure 3 illustrates the single-input single-output case of FDH production possibility frontier. DMU's A and B use input XA and XB to produce outputs YA and YB, respectively. The input efficiency score for country B is defined as the quotient XA/XB. The output efficiency score is given by the quotient YB/YA.

DMU's A, C, and D are efficient using the definition of FDH frontier, while the DMU B is not efficient. The DMU is called efficient if its score equals one, and this implies that the country is on the frontier. While, the score of 0.67 indicates that this particular DMU uses more inputs than the most efficient DMU to achieve the same output level. If DMU has an output efficiency score of 0.67, this indicates that the inefficient producer attains 67 percent of the output obtained by the most efficient producer with the same input intake.

Figure (3)



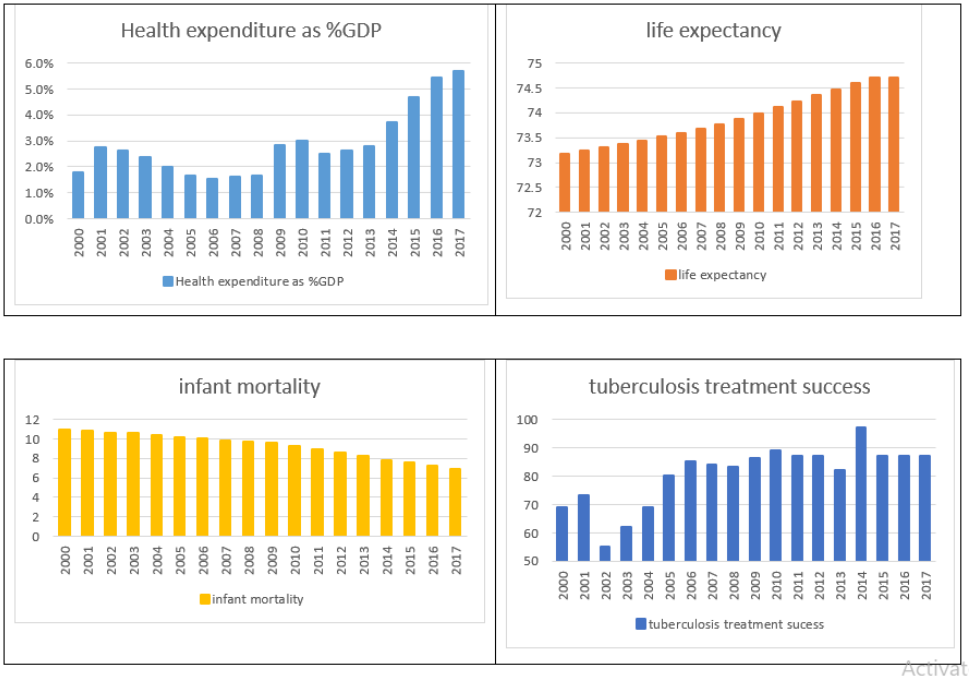
3.2 Data description.

Kuwait is devoting significant resources to the health sector , on average health expenditure is around 2.8% ± 1.3% % of GDP . Expenditure reveals an increasing trend during 2010-2017. Government spending lead to improvement in health outcomes indicators, as the life expectancy has increased to 74.69 years in 2017. Infant mortality rate in Kuwait has declined during 2010-2017 from 10.9 per thousands in 2010 to 6.9 per thousands in 2017. Tuberculosis treatment success rate in Kuwait during the same period has increased from 55% to 97%. Table (1) in the annex.

Below, figure (4) illustrates the outputs indicators measuring the efficiency of Kuwait's health sectors and the health expenditure:

- Life expectancy
- Infant mortality
- Tuberculosis treatment success.

Figure (4): input and output for health sector variables over years.



Source: World bank development indicators

There are no outliers in the health expenditure as a percent of GDP as an inputs for measuring efficiency, they are to some extent normally distributed, so there is no need to deal with the logarithm scale of health expenditure as a percent of GDP. Table (2) in the annex.

To check how the input variable is correlated with the chosen output indicators, a correlation analysis between input and output variables for health

sector has been conducted, table (4). It is clear that there is a strong significant positive correlation analysis between health expenditure as a percent of GDP and life expectancy, and life expectancy index this with a 95% confidence. The analysis reveals also a weak positive significant correlation between health expenditure as a percent of GDP and tuberculosis treatment success this with 95% confidence interval. Also, there is negative strong significant correlation between health expenditure as percent of GDP and infant mortality with a 95% confidence interval.

Table (4): Person Correlations

	life expectancy	life expectancy index	infant mortality	tuberculosis treatment success
Health expenditure as %GDP	.795**	.806**	-.830**	.366**

** significant at 5% significance.

4. Results of DEA and FDH analysis:

The analysis is initially conducted with a single output, i.e. 1input-1output analysis. Following, an analysis of aggregate outputs is performed with 1input-multiple outputs. Also variable and constant return to scales in addition to FDH are presented for both input efficiency and output efficiency. The following results are obtained by using R-software.

✓ According to the output indicator ***life expectancy index***, expenditure on health in Kuwait in 2006 is efficient in terms of input and output efficiency using (VRS, CRS, FDH) measurements, and in 2011,2013, 2016 and 2017 using (VRS, FDH) measurements. The reasons behind the efficiency in these years are due to the fact that it gave the highest score values for the outcomes (outputs), which was an indication of a considerable good public resources' appropriation done by the Kuwaiti government during this year. It is true that one could wonder whether other variables such as the level of education, health culture, and even legislations, in addition to increasing health expenditure would drive better outcomes (outputs) such as life expectancy, infant mortality, and tuberculosis treatment success, but this is out of the scope of the paper.

✓ Also input ***inefficiency ranges between 0.172 to 0.96 which indicates that during the years that are input inefficient, Kuwait spent more than the efficient years and achieving the same life expectancy index as the efficient years***. Output inefficiency ranges between from 0.172 to 0.96 which indicates that during the years that are output inefficient Kuwait achieves lower percentage of life expectancy index than the efficient years without increasing public spending than efficient years.

✓ According to the output indicator ***infant mortality***, expenditure on health in Kuwait is efficient in 2006, in terms of input and output efficiency using (VRS, CRS, FDH) measurements, and in 2000 using (VRS, FDH measurements. Input inefficiency ranges between from 0.115 to 0.778 which indicates that during the years that are input inefficient Kuwait spent more than the efficient years and achieving the same infant mortality rate as the efficient years. Output inefficiency ranges between from 0.115 to 0.998 which indicates that during the years that are output inefficient Kuwait achieves higher percentage of infant mortality index than the efficient years without increasing public spending.

✓ According to the output indicator ***tuberculosis treatment success***, expenditure on health in Kuwait is efficient in 2006 in terms of input and output efficiency using (VRS, CRS, FDH) measurements, and on 2014 using (VRS, FDH) measurements. Input inefficiency ranges between from 0.171 to 0.75 which indicates that during the years that are input inefficient Kuwait spent more than the efficient years and achieved the same tuberculosis treatment success as the efficient years. The output inefficiency ranges between from 0.171 to 0.978 which indicates that during the years that are output inefficient Kuwait achieved a lower percentage of tuberculosis treatment success than the efficient years, without increasing the public spending than efficient years. In general, FDH analysis reveals that the years with efficient spending are more than that what is revealed by the DEA analysis.

Figure (5): DEA and FDH efficiency for the output indicator

life expectancy index

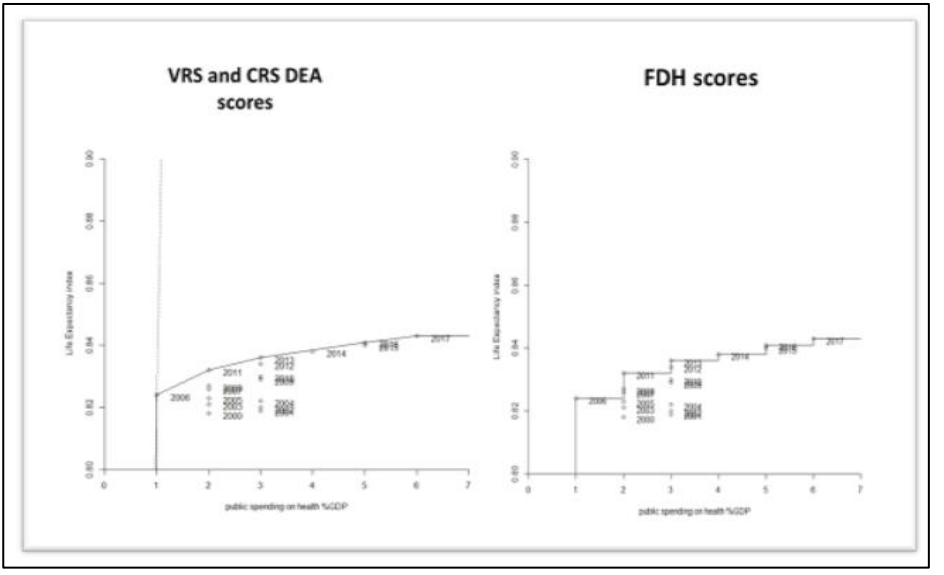


Figure (6): DEA and FDH efficiency for the output indicator

infant mortality rate

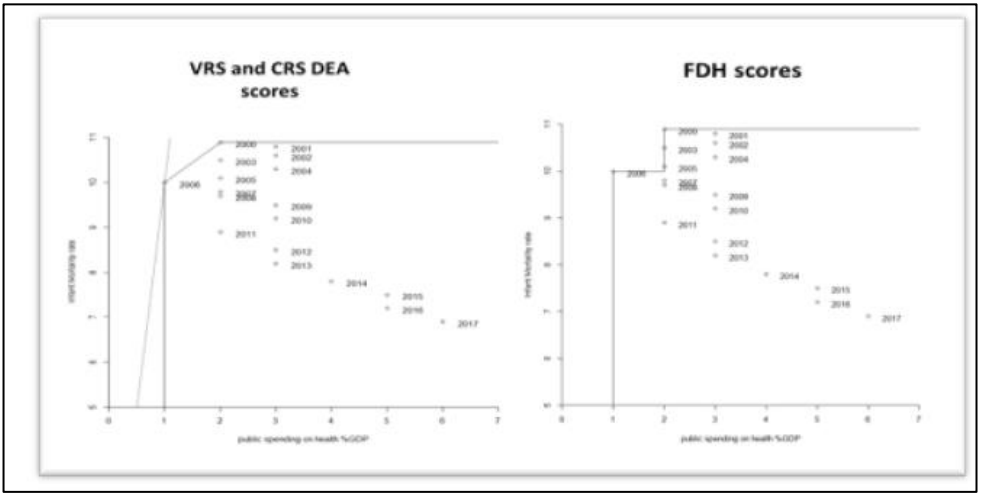
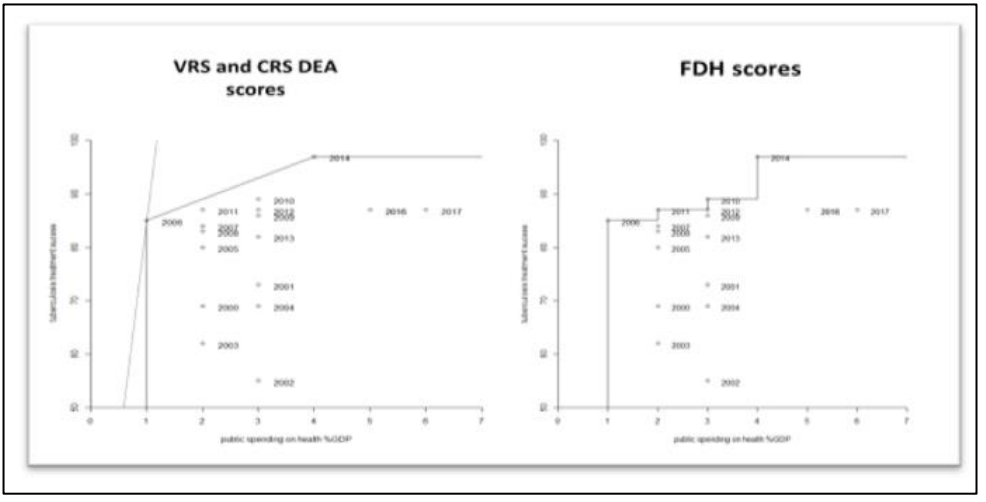


Figure (7): DEA and FDH efficiency for the output indicator tuberculosis treatment success



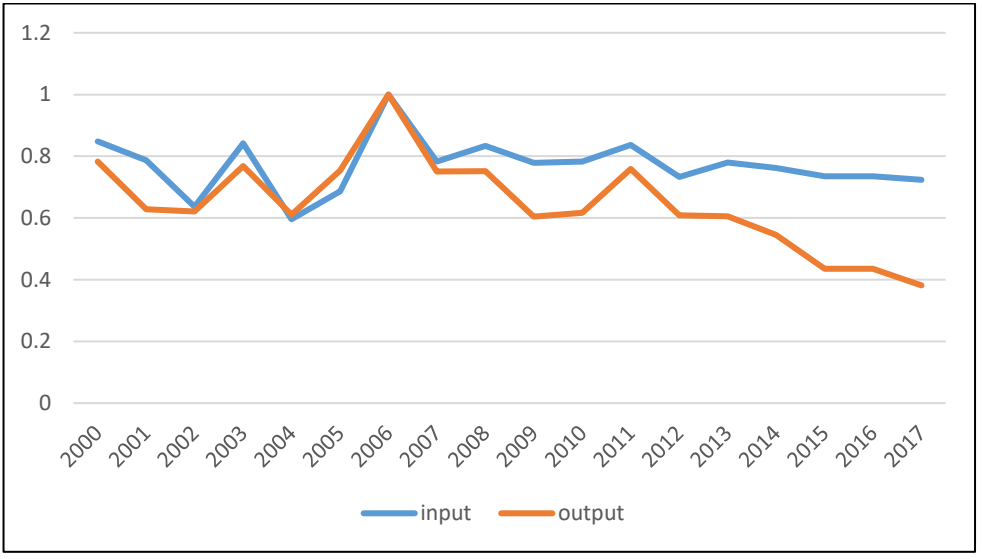
After presenting the single input-single output analysis, now we will present the single output- multiple input analysis. Note that the average for the three measures (CRS, VRS, FDH) is calculated for each of input and output efficiency to measure specifically which year is efficient. From table (3) in the annex we can conclude that year 2006 is an efficient year in health sector and this in terms of inputs and outputs. The year with the least input inefficiency is year 2004. This means that in year 2004 Kuwait spent more on heath than year 2006 and other inefficient years and achieving the same rate of the health output indicators (in other words far from frontier).

The year with highest input inefficiency is year 2000. This means that in year 2000 Kuwait spent more on health than year 2006 (but not more than other inefficient years) and achieving the same rate of the output health indicators (in other words near from frontier). The year with the least output inefficiency is year 2017. This means that in year 2017 if Kuwait spent on health the same as year 2006 and other inefficient years it would achieve a lower rate of the output health indicators.

The year with highest output inefficiency is year 2000. This mean that in year 2000 if Kuwait spent on health the same as year 2006 but achieved a lower rate of the outputs than 2006, but more than other inefficient years (in other words near from frontier). From figure (8) it is clear that health input and health output

efficiency take almost the same trend over years. However, the fluctuations within health output inefficiency are greater than the fluctuations within health input inefficiency.

Figure (8): Input& output efficiency over years in health sector



Finally, after presenting the efficiency of the public spending on health in Kuwait we will study the relationship between efficiency scores in health sector and health output indicators. Table (5) presents the relationship between efficiency scores and the output indicators. It is clear that there is positive significant correlation between each of output indicator and input efficiency and output efficiency except for infant mortality rate that is negatively significant correlated with input and output efficiency score. The negative relationship appears as the government seeks to decrease infant mortality rate. This ensures the compatibility of the chosen output indicators.

Table(5): Spearman's rho Correlations between input and output efficiency scores in health sector and the health output indicators

		life expectancy index	infant mortality	tuberculosis treatment success
Spearman's rho	input efficiency	.279**	-.279**	.390*
	output efficiency	.752***	-.752***	.522*

*** sig. at 0.01, ** sig. at 0.05, * sig. at 0.1.

In conclusion, Kuwait achieved a significant improvement in health outcomes over the past 20 years, especially in terms of increasing life expectancy and reducing infant mortality. It spends more than double emerging markets average on healthcare, while health outcomes are marginally above the emerging markets average. The empirical results show that on average, public spending in health sector is inefficient, which means that performance in this sector can be enhanced without increasing expenditure. it was found that on average the health sector outcomes can be increased by 35% without spending more resources and the same results can be achieved by reducing public spending by 23%. Building on the above main findings of the paper, it is important for the policy maker to give more attention to improve the efficiency of public sector expenditure in order to improve the health sector outcomes. The following recommendations can be considered:

- Improving health sector governmental plans by considering a bottom-up approach (or participatory approach) in setting any health sector agenda. Such approach can guarantee better government appropriations when considering citizens' view and civil society.
- Developing a better following up mechanism which is based on a better health database.
- Approving better quality standards in the health sector to improve the health outcomes per Kuwaiti dinar spent on the sector.
- Introducing better governance frameworks in the health sector which reduces wasteful healthcare resources and ensures full coordination across all healthcare institutions.
- The Kuwaiti government has a room for saving through tightening eligibility for treatment abroad and promoting private sector participation through privatization and public private partnership.

Footnote

(1) This technique has many advantages as it doesn't require specifying functional form for production technology. It can be used in the case of multi-inputs multi outputs and when we have one output or aggregate output.

(2) Investcorp insights: https://www.investcorp.com/wp-content/uploads/2020/01/Healthcare_WhitePaper_Mar18.pdf

(3) https://www.bain.com/insights/a-healthcare-prescription-for-the-gcc/

(4) See investcorp,op.cit.

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Annex

Table (1): Descriptive statistics of input and output variables for Health sector in Kuwait during 2010-2017

		Minimum	Maximum	Mean	Std. Deviation
Input	**Health expenditure as %GDP**	1.5%	5.7%	2.8%	1.3%
Output	**life expectancy**	73.160	74.694	73.88539	.517180
	life expectancy index	.818	.843	.82906	.008098
	infant mortality	6.9	10.9	9.244	1.2867
	tuberculosis treatment success.	55	97	80.50	10.684

Table (2): Test of Normality

	Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Health expenditure as %GDP	**.224**	**18**	**.017**	**.847**	**18**	**.008**
life expectancy	**.109**	**18**	**.200***	**.934**	**18**	**.227**
life expectancy index	**.123**	**18**	**.200***	**.939**	**18**	**.281**
infant mortality	**.138**	**18**	**.200***	**.929**	**18**	**.187**
tuberculosis treatment sucess	**.222**	**18**	**.019**	**.874**	**18**	**.021**

***. This is a lower bound of the true significance.**

a. Lilliefors Significance Correction

b. It is clear that Health expenditure as % GDP, and tuberculosis treatment success are not normally distributed with confident 95% as the p-value (sig.) are less than 5%, while the other variables are normally distributed with confident 95% as the p-value (sig.) are larger than 5

Table (3): Results of DEA & FDH single input-single output efficiency in health sector during 2000-2017

		Input			**Output**		
	year	VRS	CRS	FDH	VRS	CRS	FDH
life expectancy index	2000	0.500	0.496	0.50	0.983	0.496	0.983
	2001	0.333	0.331	0.33	0.980	0.331	0.980
	2002	0.333	0.332	0.33	0.981	0.332	0.981
	2003	0.500	0.498	0.50	0.987	0.498	0.987
	2004	0.333	0.333	0.33	0.983	0.333	0.983
	2005	0.500	0.499	0.50	0.989	0.499	0.989
	2006	1	1	1	1	1	1
	2007	0.625	0.501	1	0.993	0.501	0.993
	2008	0.688	0.502	1	0.994	0.502	0.994
	2009	0.542	0.335	0.667	0.992	0.335	0.992
	2010	0.583	0.336	0.667	0.993	0.336	0.993
	2011	1	0.505	1	1	0.505	1
	2012	0.833	0.337	1	0.998	0.337	0.998
	2013	1	0.338	1	1	0.338	1
	2014	0.950	0.254	1	0.999	0.254	1
	2015	0.920	0.204	1	0.999	0.204	0.999
	2016	1	0.204	1	1	0.204	1
	2017	1	0.171	1	1	0.171	1
infant mortality	2000	1	0.545	1	1	0.545	1
	2001	0.630	0.360	0.667	0.991	0.360	0.991
	2002	0.556	0.353	0.667	0.972	0.353	0.972
	2003	0.778	0.525	1.000	0.963	0.525	0.963
	2004	0.444	0.343	0.667	0.945	0.343	0.945
	2005	0.556	0.505	1	0.927	0.505	0.927
	2006	1	1	1	1	1	1
	2007	0.5	0.49	0.5	0.899	0.490	0.899
	2008	0.5	0.485	0.5	0.890	0.485	0.890
	2009	0.333	0.317	0.333	0.872	0.317	0.872
	2010	0.333	0.307	0.333	0.844	0.307	0.844
	2011	0.5	0.445	0.5	0.817	0.445	0.817
	2012	0.3333	0.2833	0.3333	0.780	0.283	0.780
	2013	0.3333	0.2733	0.3333	0.752	0.273	0.752
	2014	0.25	0.195	0.25	0.716	0.195	0.716
	2015	0.2	0.15	0.2	0.688	0.150	0.688
	2016	0.2	0.144	0.2	0.661	0.144	0.661
	2017	0.167	0.115	0.167	0.633	0.115	0.633

tuberculosis treatment success	2000	0.50	0.41	0.50	0.78	0.41	0.79
	2001	0.33	0.29	0.33	0.78	0.29	0.82
	2002	0.33	0.22	0.33	0.59	0.22	0.62
	2003	0.50	0.36	0.50	0.70	0.36	0.71
	2004	0.33	0.27	0.33	0.74	0.27	0.78
	2005	0.50	0.47	0.50	0.90	0.47	0.92
	2006	1	1	1	1	1	1
	2007	0.500	0.494	0.500	0.944	0.494	0.966
	2008	0.500	0.488	0.500	0.933	0.488	0.954
	2009	0.417	0.337	0.667	0.925	0.337	0.966
	2010	0.667	0.349	1	0.957	0.349	1
	2011	0.750	0.512	1	0.978	0.512	1
	2012	0.500	0.341	0.667	0.935	0.341	0.978
	2013	0.333	0.322	0.333	0.882	0.322	0.921
	2014	1	0.285	1	1	0.285	1
	2015	0.300	0.205	0.400	0.897	0.205	0.897
	2016	0.300	0.205	0.400	0.897	0.205	0.897
	2017	0.250	0.171	0.333	0.897	0.171	0.897

Figure (1): Histogram of public spending as % GDP for the health sector in Kuwait