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Fight Against COVID-19: Evaluation of the Efficiency of Arabic Countries using DEA

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Abstract:

This study aimed to evaluate the efficiency of countries in controlling COVID-19 contagion for April. A sample of 14 Arab countries was taken using a DEA method under an input-oriented BCC model. The population density and days since the first confirmed case were recorded as input, and the average contagion rate as output. The results reveal that Libya, Saudi Arabia, and Bahrain are the countries with full efficiency in contagion control that can be looked upon for control of COVID-19 contagion. United Arab Emirates achieved efficiency during the first period. Egypt achieved the least efficiency rate. Qatar, Sudan, Morocco, Algeria, Tunisia, Kuwait, Jordan, and Oman have experienced inefficiency in preventing COVID-19 contagion.

Keywords: COVID-19 contagion, efficiency evaluation, data envelopment analysis, Arab countries.

Jel Classification Codes: C67, D24, I18

1. INTRODUCTION

In late 2019, a novel coronavirus emerged in Wuhan, Hubei province, China. On February 11, 2020, the Coronavirus Study Group of the International Committee on Taxonomy of Viruses officially named this new coronavirus as SARS-CoV-2. The same day, the World Health Organization (WHO) named the disease it causes as COVID-19, which stands for Coronavirus Disease 2019. (Li, 2020, p. 1)

The COVID-19 virus, also known as nCOV-2019, has rapidly spread across 31 provinces and regions. As of March 5, 2020, a total of 98,067 new confirmed cases were reported internationally. (Cheng, Zhao, Kaminga, Zhang, & Xu, 2020, p. 2) The symptoms of COVID-19 include fever, cough, fatigue, shortness of breath, pneumonia, and other respiratory tract symptoms. These symptoms may take up to 14 days to manifest after exposure to the coronavirus, which is considered the longest known infectious period for this illness by medical professionals.

The COVID-19 pandemic represents a significant humanitarian crisis, with the virus spreading rapidly across the globe, including the Arab region. Daily reports of new cases highlight the urgent need for a comprehensive understanding of the virus's trends to effectively contribute to its treatment and prevention. This requires collaborative efforts from countries worldwide, focusing on various aspects of the virus. These include monitoring the pathogen, identifying its sources, understanding its primary etiology, developing clinical treatments, creating vaccines, studying viral replication, exploring pathogenesis, discovering antiviral drugs, and more. Ongoing research in these areas is crucial for combating the virus effectively**.**(Lee, Heo, & Kim, 2020, p. 2)

Assessing the efficiency of countries in their response to the COVID-19 pandemic is crucial for understanding their performance and identifying areas for improvement. Data Envelopment Analysis (DEA) is a useful tool for comparing the efficiency of each country with others in the dataset. DEA estimates the efficiency of a unit under evaluation by comparing it to other units in the dataset. After completing this process for every country, all countries are categorized into either an efficient collection, which has an

efficiency score of 100%, or an inefficient collection, which has an efficiency score below 100%. This analysis provides valuable insights into the performance of countries in their COVID-19 response efforts, allowing for targeted improvements and policy adjustments. (Emrouznejad, Banker, Ahn, & Afsharian, 2016, p. 1)

Many studies have been published on the topic under study these are Some later studies that will help complete the current study.

The study conducted by **(Breitenbach, Ngobeni, & Aye, 2020)** aimed to analyze the efficiency in containing the spread of the COVID-19 virus in the 31 most infected countries during the first 100 days since the outbreak. Utilizing data envelopment analysis, the study identified four key inputs: the number of days to lockdown, number of doctors per 1000 population, total tests per 1 million population, and spending on health as a percentage of GDP. The study also measured one output: the number of days left in a cycle after reaching persistent COVID-19 reduced infections (Spared days). The findings revealed that 12 out of the 31 countries in the sample were efficient in their resource utilization for managing the flattening of their COVID-19 contagion curves, while 19 countries were found to be inefficient. Notably, some of the world's wealthiest countries, such as Germany, Canada, and the USA, were among the worst performers in this regard.

, The study conducted by **(Shirouyehzad, Jouzdani, & Khodadadi-Karimvand, 2020)** aimed to evaluate the performance of the 29 most seriously affected countries in controlling the COVID-19 contagion and medical treatment using two-stage data envelopment analysis. The first stage utilized two inputs: population density and an average of 13 Intensive Care Units per 100,000 population. The output measured was the number of confirmed cases. In the second stage, the input was the number of confirmed cases, while the outputs were the number of death cases and recovered cases. The results indicated that Singapore, Vietnam, and Belgium were the countries with the highest efficiency in both aspects. Specifically, Singapore, despite having one of the highest population densities in Southeast Asia, demonstrated the highest efficiency among the countries. In Europe, Belgium was the most efficient, while Italy was the least efficient. In the Middle East, Iran was the most efficient in controlling the contagion, while Egypt was the least efficient. Interestingly, Egypt was

the most efficient in medical treatment, whereas Iran was the least efficient in this aspect.

In another study conducted by **(Shirouyehzad, Jouzdani, & Khodadadi-Karimvand, 2020)**, the performance of the most severely affected European countries was estimated based on the average contagion rate over two weeks. The sample consisted of 30 countries. The study utilized the Malmquist productivity index, which measured two inputs: days since the first confirmed case and population density, and one output: average contagion rate. The results indicated that Russia, Germany, and France did not exhibit high relative contagion rates in either of the two weeks. Italy, on the other hand, showed a growth in relative contagion rate. Spain also experienced an increase from the first week to the second. Belgium, the UK, Portugal, Ukraine, and Latvia exhibited the same trend. Iceland, however, maintained a constant contagion rate throughout the two weeks. The high contagion rate in these countries can be attributed to their low population density.

In a study conducted by (**Ghasemi, Boroumand, & Shirazi, 2020)**, the inefficiency of preventing the spread of COVID-19 and the inefficiency of preventing deaths caused by the virus were analyzed from February 2 to April 12. The sample consisted of 19 countries, and the study utilized Data Envelopment Analysis with the Malmquist index. The first model used two inputs (population and population density) and one output (confirmed coronavirus cases), while the second model used three inputs (population, population density, and the percentage of the population aged 65 and above) and one output (confirmed coronavirus deaths). The results indicated that the inefficiency trend of preventing the spread of COVID-19 in Singapore, South Korea, China, and Australia was decreasing during the period under review. Additionally, Australia, Finland, Japan, Malaysia, Singapore, and Thailand experienced less inefficiency in preventing deaths caused by the coronavirus compared to other countries.

The Arab region faces numerous challenges, including resource scarcity and inadequate healthcare infrastructure, which exacerbate the virus's proliferation and dissemination. In response, authorities have implemented a series of measures and raised public awareness about the

severity of the disease and the necessity of adhering to the World Health Organization's guidelines. This leads to the inquiry: What is the efficiency level of COVID-19 containment in Arab states, as per the findings of data envelopment analysis?

The significance of studying the efficiency of Arab countries in controlling the spread of COVID-19 is manifold. Firstly, the subject matter is highly sensitive at both regional and international levels. Secondly, understanding the efficiency in controlling COVID-19 contagion is crucial as it has implications for the efficiency of other sectors, particularly the economic sector. This study could assist regulators in improving their performance.

To measure the efficiency of countries in combating the spread of COVID-19, we employed the Input-Oriented BCC (Variable Returns to Scale) model, a type of Data Envelopment Analysis (DEA). This model allows us to estimate efficiency under the assumption of variable returns to scale. The setup for this analysis is based on established DEA methodologies. Applying this model to a sample of Arab countries, we aimed to determine factors affecting the efficiency of the procedures used by states to prevent the outbreak of the pandemic.

This study is divided into six section:

In The first section, the introduction was presented;

in The second section, the methodology used is defined;

In the third, The results of study is presented;

In the fourth, , the work was concluded.

2.Methodology

2.1 Data Envelopment Analysis

The technique was introduced by American operations research researchers Charnes, Cooper, and Rhodes in 1978 **(Liao, et al., 2016, p. 2710).** .In this technique, the organization transformed inputs into outputs. **(Cooper, Seiford, & Lone, 2002, p. 22)**

Data envelopment analysis is a data-oriented method **(Cooper, Seiford, & Zhu, 2011, p. 01)** This technique is used to measure the relative efficiency of practically identical Decision Making Units (DMUs). (**Laplante**, **2012**,

p. 11), This method is utilized to assess the relative efficiency of similar Decision Making Units (DMUs) by establishing an efficiency frontier from a set of observations of these units, without the need to define a specific production function**. (Castañeda & Mauricio, 2020, p. 06)**

Numerically, the foundation of a proficient frontier utilizes the proportion of the weighted sum of several outputs to the weighted sum of several inputs, assume there are n DMUs (j=1,2,…n) and each **DMU** utilizes m inputs (Xi) (i=1,2,…,m) to yield s outputs (Yr) (r=1,2,…,s) **(Arsana, 2014, p. 56)**. the efficiency is estimated as follows: **(Sueyoshi & Goto, 2018, p. 27)**

Efficiency =(sum of total weighted desirable outputs)
(sum of total weighted inputs)

$$efficiency = \left(\sum_{r=1}^{s} ur\ grj\right) / \left(\sum_{i=1}^{m} vi\ xij\right)$$

Where:

$\mathbf{u_r}$ = weights input

$\mathbf{V_i}$ = weights output

$\mathbf{g_{rj}}$ **=** the **r**-th desirable output

$\mathbf{x_{ij}}$ = the **i**-th input of the **j**-th DMU

Data Envelopment Analysis (DEA) encompasses various models, including both input-oriented and output-oriented approaches. Input-oriented DEA models are particularly focused on identifying potential reductions in inputs while maintaining the current levels of outputs. Conversely, output-oriented models aim to determine possible increases in outputs while keeping inputs constant.

Two prominent models used to assess the efficiency of Decision-Making Units (DMUs) are the CCR (Charnes, Cooper, and Rhodes) model and the BCC (Banker, Charnes, and Cooper) model. The BCC model is classified as a Variable Returns to Scale (VRS) model, which contrasts with the CCR model, which is categorized as a Constant Returns to Scale (CRS) model.

DATA:

- The sample of this study is consists of (14) Arabic countries. The

efficiency of countries with regard to the effective prevention of the spread of the COVID-19 pandemic will be analyzed. (**see Table 01).**

- The data are obtained from the World Health Organization 2020 and other resources.
- The efficiency was measured through the use of R software.

Table.1. the countries

NO	Country
01	Algeria
02	Tunisia
03	Morocco
04	Libya
05	Egypt
06	Sudan
07	Mauritania
08	Saudi Arabia
09	Oman
10	Bahrain
11	Qatar
12	Kuwait
13	United Arab Emirates
14	Jordan

Source: prepared by authors

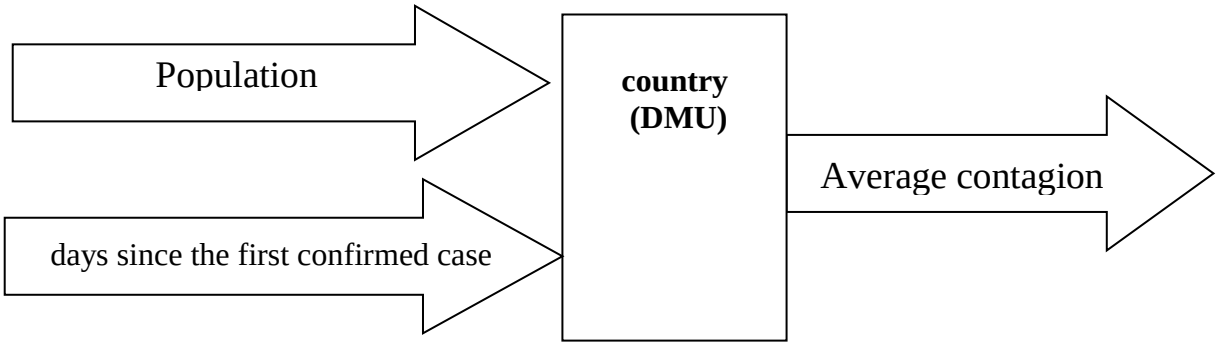
2.2 The input and output:

The selection of inputs and outputs in the Data Envelopment Analysis (DEA) model is indeed highly sensitive to data accuracy. Therefore, it is crucial to choose these variables with utmost care to ensure the accuracy of the efficiency scores obtained. (Coelho, 2014) In a study pointed out by a researcher, it was highlighted that variations in the composition of inputs and outputs can lead to different results in terms of efficiency. Furthermore, the efficiency and inefficiency of decision-making units are significantly influenced by the selection of inputs and outputs.

In this study, we used the **"input-oriented BCC model "** with variable return to scale that is used by (Shirouyehzad, Jouzdani, & Khodadadi-Karimvand, 2020, p. 13) in their study, we also used the same variables, for being more reasonable input and output. **(see figure.1.)**

And the (Ghasemi, Boroumand, & Shirazi, 2020, p. 14) employed population density as an input variable to evaluate the efficiency of countries in combating COVID-19. Various factors, both human-driven and inherent, can influence the spread of the virus when population density is high. Population density is calculated by dividing the total population by the area, serving as a fundamental unit in urban development. The average contagion rate is determined by dividing the total change in confirmed COVID-19 cases over two consecutive days by a constant period of 15 days, as per our study. The objective of this research is to assess the efficiency of countries in their response to the COVID-19 pandemic.

Fig.1. the general scheme of the DEA model



Source: prepared by authors

3. Result and Discussion:

Table2. the input and output data for two time period

No	Country	Input		output
		Population Density	days since the first confirmed case	Average contagion rate
01	Algeria	*18*	*49*	*99.7*

02	Tunisia	*76*	*43*	*29*
03	Morocco	*83*	*43*	*88.8*
04	Libya	*4*	*21*	*1.8*
05	Egypt	*103*	*60*	*116.07*
06	Sudan	*25*	*32*	*1.73*
07	Mauritania	*5*	*31*	*0.13*
08	Saudi Arabia	*16*	*43*	*259.27*
19	Oman	*16*	*50*	*48.73*
10	Bahrain	*2.239*	*50*	*67.53*
11	Qatar	*248*	*45*	*181.93*
12	Kuwait	*240*	*51*	*72.6*
13	United Arab Emirates	*118*	*77*	*272.87*
14	Jordan	*115*	*43*	*8.2*

Sources: Internet websites (see in Bibliography List)

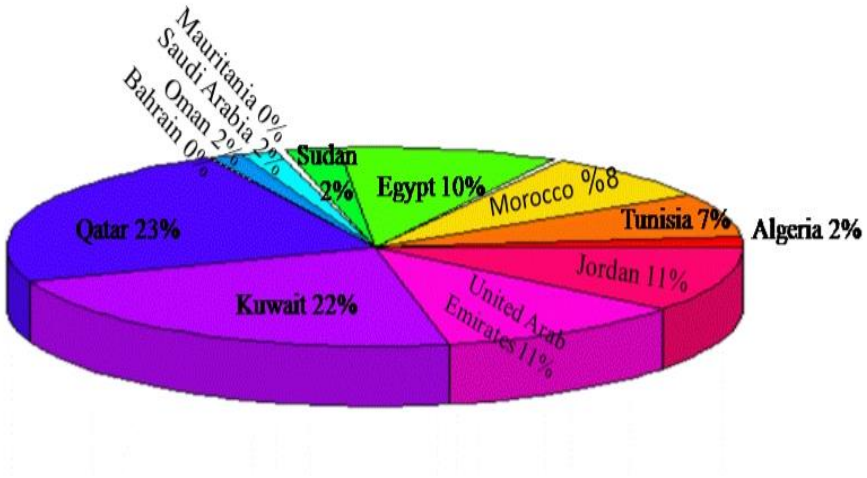
Table.2. the input and output data for two time period

No	Country	Input		output
		Population Density	days since the first confirmed case	Average contagion rate
01	Algeria	*18*	*64*	*113.27*
02	Tunisia	*76*	*58*	*15.53*
03	Morocco	*83*	*58*	*162.2*
04	Libya	*4*	*36*	*1.73*
05	Egypt	*103*	*75*	*194.53*
06	Sudan	*25*	*47*	*22.87*
07	Mauritania	*5*	*46*	*0*
08	Saudi Arabia	*16*	*58*	*1067.07*
09	Oman	*16*	*65*	*90.93*
10	Bahrain	*2.239*	*65*	*92.87*
11	Qatar	*248*	*60*	*609.07*
12	Kuwait	*240*	*66*	*159*
13	United Arab Emirates	*118*	*92*	*478.67*
14	Jordan	*115*	*58*	*3.33*

Sources: Internet websites (see in Bibliography List)

Figure .2. shows The population density ratio for each country shows that Qatar and Kuwait are among the most populous countries with a density rate of 23% and 22% respectively, Jordan and the UAE come at an 11% rate, Egypt at a rate of 10%, Morocco at 8%, Tunisia at a rate of 7%, Algeria, Sudan, Saudi Arabia and Oman at a rate of 2%.

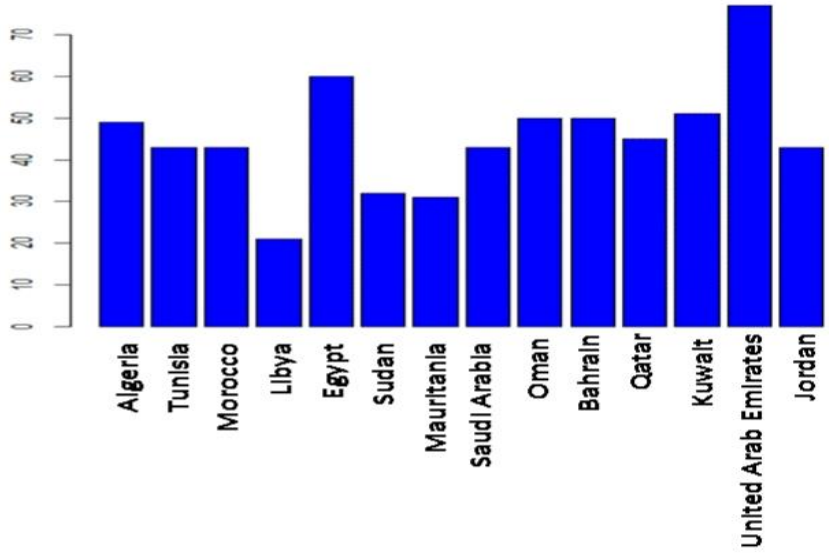
Fig.2. Population Density



Source: R programming outcome

By observing Figure.3. The number of days since the first confirmed case of the virus appeared, the United Arab Emirates is the first Arab country to have the Coronavirus, then Egypt, then Kuwait, and appeared on the same day in Bahrain and Oman, then it moved to Algeria, Qatar, and recorded on the same day each Saudi Arabia, Jordan, Tunisia and Morocco first confirmed cases, then moved to Sudan and then Mauritania, Libya was the last country in the sample where the virus appeared.

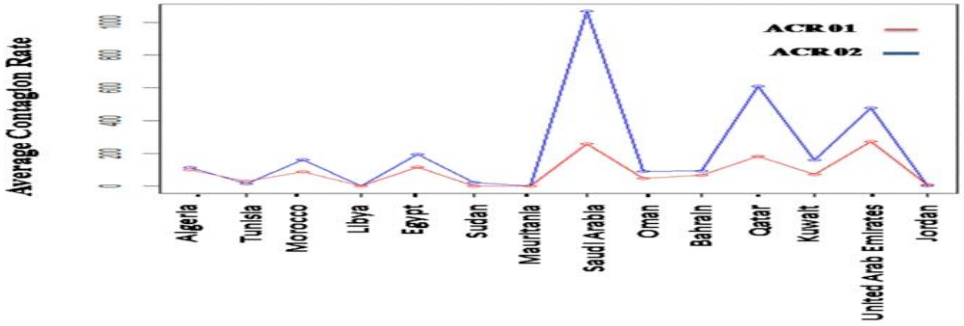
Fig.3. day since the first confirmed case until the end of April



Source: R programming outcome

See Figure 4. The average infection rate for April is that infection rates rose in all countries from the first 15 to the second 15 days except for four countries: Tunisia, Libya, Mauritania and Bahrain, and Saudi Arabia recorded the largest average infection rate of 1067.07 while Mauritania recorded the smallest infection rate of 0.

Figure.4.Average contagion rate for April



Source: R programming outcome

RESULTS:

To measure the efficiency of countries in controlling COVID-19 contagion, input and output data were collected for April, and efficiency was calculated

every 15days separately. (see Table .3.)

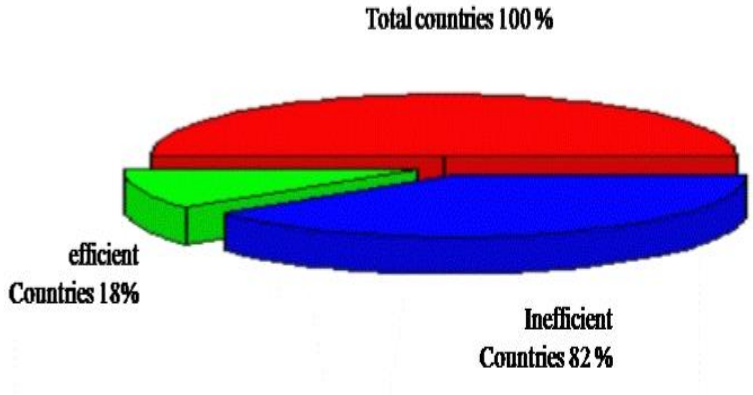
Table.3. Average efficiency of the countries and their ranks.

No.	Countries	First 15 days efficiency	Second 15 days efficiency	Average efficiency	Average efficiency rank
01	Algeria	0.599	0.598	0.598	9
02	Tunisia	0.542	0.625	0.583	10
03	Morocco	0.661	0.677	0.669	8
04	Libya	1.000	1.000	1.000	1
05	Egypt	0.512	0.533	0.522	14
06	Sudan	0.656	0.775	0.715	7
07	Mauritania	0.766	0.793	0.779	5
08	Saudi Arabia	1.000	1.000	1.000	1
09	Oman	0.500	0.582	0.541	13
10	Bahrain	1.000	1.000	1.000	1
11	Qatar	0.808	0.809	0.808	4
12	Kuwait	0.530	0.594	0.562	11
13	United Arab Emirates	1.000	0.498	0.749	6
14	Jordan	0.501	0.621	0.561	12

Source: R programming outcome

Table.3. indicates the average of efficiency scores for each country during April under the input-oriented for 14 Arab countries showed that four countries achieved efficiency in preventing the spread of COVID-19 contagion during the first 15 days of April, namely Libya, Saudi Arabia, Bahrain, and the United Arab Emirates, and maintained efficiency during the second 15 days, with the exception of the United Arab Emirates, which decreased to 0.498; that shows 3 out of 14 countries achieved full efficiency during that month. (see figure .5.)

Fig 5.ratio of efficient countries to total countries for April

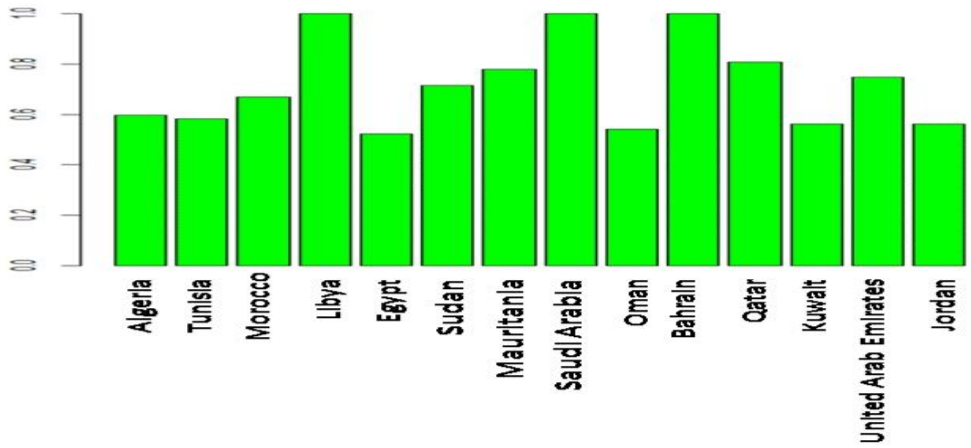


Source: R programming outcome

On average, Egypt achieved the least efficiency rat, with the countries ranked as follows: first Libya, Saudi Arabia, and Bahrain, followed by Qatar, Mauritania, United Arab Emirates, Sudan, Morocco, Algeria, Tunisia, Kuwait, Jordan, Oman and then Egypt.

Figure.6. reveals the rank of countries to the average efficiency scores, and it's obvious how are three countries (Libya, Saudi Arabia, Bahrain) leader in Arab countries, and Egypt is the least efficient country of all data sample.

Fig.6.ranking of countries according average efficiency scores

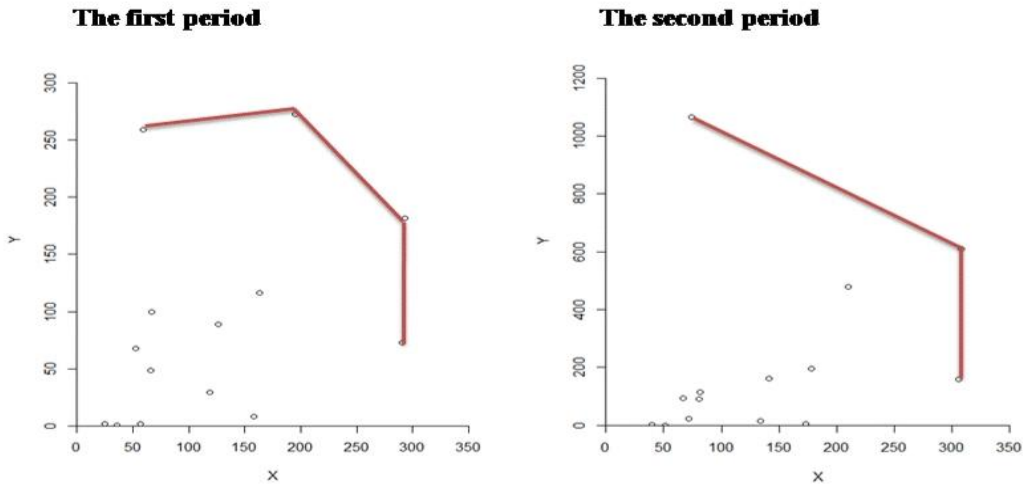


Source: R programming outcome

Looking at Figure 6, which shows the two-period frontier efficiency curve From April we notice that All countries that fall on the frontier efficiency

curve are efficient with an efficiency degree equal one, and countries that fall below the frontier efficiency curve are inefficient with an efficiency score less than one.

Fig.7. frontier efficiency curve



Variable	Min	1st Q4.	Median	Mean	3rd Q4.	Max	#	%
VRC	0.5002	0.5334	0.6588	0.7199		0.9522		
First 15 days	1.000							
Eff range	0.5<= E < 0.6						6	42.9
	0.6<= E < 0.7						2	14.3
	0.7<= E < 0.8						1	7.1
	0.8<= E < 0.9						1	7.1
	0.9<= E < 1						0	0.0
	E= = 1						4	28.6

Second 15days	0.4984 0.5956 0.6517 0.7221 0.8052 1.000	#	%
Eff range	0.4 <=E < 0.5	1	7.1
	0.5<= E < 0.6	4	28.6
	0.6<= E < 0.7	3	21.4
	0.7<= E < 0.8	2	14.3
	0.8<= E < 0.9	1	7.1
	0.9<= E < 1	0	0.0
	E= = 1	3	21.4

Table.4.descriptive statistics of efficiency score

Source: R programming outcome

By observing Table.5. Which shows the slack of efficiency, the number of inputs to be reduced and the amount to be added to outputs for getting efficiency, we find that during the first 15 days of April, the efficiency of the Arab countries is achieved by reducing the population density by an average of 36.014 while keeping the averages contagion rate unchanged. Except for Mauritania, we can maintain the level of inputs and increased output (undesirable) by 7.927 should be maintained, and the State of Sudan should reduce the population density entry by 12.406 and increase the output by 0.070. For the second period of April, the average population density reduction is estimated at 43.653. For Mauritania, population density must be maintained and output (undesirable) increased by 3.343.in order to achieve level of efficiency equal to one.

Table.5. the slack of efficiency

No.	countries	First 15 days efficiency	slack	Sx1	Second 15 days efficiency	slack	Sx1
01	Algeria	0.599	TRUE	2.224	0.598	TRUE	5.516
02	Tunisia	0.542	TRUE	35.956	0.625	TRUE	43.390
03	Morocco	0.661	TRUE	46.829	0.677	TRUE	50.451
04	Libya	1.000	FALSE	0.0000	1.000	FALSE	0.000
05	Egypt	0.512	TRUE	43.485	0.533	TRUE	48.736
06	Sudan	0.656	TRUE	12.406	0.775	TRUE	15.143
07	Mauritania	0.766	TRUE	0.000	0.793	TRUE	0.000
08	Saudi Arabia	1.000	FALSE	0.000	1.000	FALSE	0.000
09	Oman	0.500	TRUE	1.815	0.582	TRUE	4.310
10	Bahrain	1.000	FALSE	0.000	1.000	FALSE	0.000
11	Qatar	0.808	TRUE	188.162	0.809	TRUE	189.799
12	Kuwait	0.530	TRUE	119.992	0.594	TRUE	136.947
13	United Arab Emirates	1.000	FALSE	0.000	0.498	TRUE	49.434
14	Jordan	0.501	TRUE	53.327	0.621	TRUE	67.426

Source: R programming outcome

DISCUSSION:

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Our findings align with existing literature, identifying three Arab countries—Libya, Saudi Arabia, and Bahrain—as fully efficient in their response to the COVID-19 pandemic in April 2020. These countries can serve as benchmarks for effective contagion control measures. Notably, the United Arab Emirates demonstrated efficiency during the initial period, corroborating the research by (Shirouyehzad, Jouzdani, & Khodadadi-Karimvand, 2020), which highlighted the country's successful containment strategies. However, the UAE's efficiency declined in the subsequent period, indicating a potential lapse in control measures, likely attributable to an increase in input levels. To achieve optimal efficiency, it is suggested that population density be reduced by 49.434. This analysis underscores the

importance of strategic resource allocation and policy adjustments to maintain effective pandemic management.

The analysis reveals that Egypt, as per the study by (Shirouyehzad, Jouzdani, & Khodadadi-Karimvand, 2020), exhibited the lowest efficiency rate in controlling COVID-19 contagion. To enhance efficiency, the population density must be reduced by 43.485 in the initial period and by 48.736 in the subsequent period. Similarly, Qatar, Sudan, Morocco, Algeria, Tunisia, Kuwait, Jordan, and Oman have been identified as inefficient in their COVID-19 containment strategies compared to other nations. In both periods, these countries would benefit from reducing their population density to improve efficiency. Mauritania presents a unique scenario, where the contagion rate was notably low during the first 15 days and absent during the second 15 days, indicating effective control measures. However, the country's efficiency was hindered by a decrease in output. According to Table 5, Mauritania could attain efficiency by maintaining input levels while increasing the undesirable output by 7.927 in the first period and by 3.343 in the second period. This study underscores the critical role of balancing input and output to achieve optimal pandemic management efficiency.

The authorities in various countries have implemented several measures to mitigate the severity of the COVID-19 contagion. These include:

1. Implementing temporary bans on entry for individuals and tourists from countries affected by the virus, as well as from other nations.
2. Closing borders and suspending travel to and from other countries for a specified duration.
3. Shutting down complex establishments such as schools, universities, mosques, and markets to curb the spread of the virus.

Frequently and thoroughly clean your hands using an alcohol-based hand sanitizer or soap and water.

2. Avoid crowded places and maintain a distance of at least 1 meter (3 feet) from others.
3. Refrain from touching your eyes, nose, and mouth.

4. Wear a fabric mask when leaving your home.
5. Stay at home unless absolutely necessary.
6. Practice good respiratory hygiene by covering your mouth and nose with your elbow or a tissue when coughing or sneezing, then dispose of the used tissue and wash your hands.

Our research, while insightful, is not without limitations. Firstly, the study is confined to a select group of Arab countries due to the limited availability of comprehensive data prior to April 1, 2020, a period when COVID-19 was not yet prevalent in these regions. Secondly, the sample exclusively comprises Arab nations, despite the global nature of the pandemic. These constraints, while acknowledged, do not diminish the value of our findings, which underscore the significant impact of population density and the role of citizens' awareness and adherence to public health measures in combating the spread of COVID-19.

4. CONCLUSION

The objective of this research is to assess the efficiency of Arab countries in their response to the COVID-19 pandemic during April 2020, with the study period divided into two equal segments to monitor the evolution of efficiency throughout the study. Employing a non-parametric methodology, the research utilizes Data Envelopment Analysis (DEA) with a dataset comprising 14 Arab countries for April 2020. The Banker, Charnes, and Cooper (BCC) model, an input-oriented model proposed by Banker, Charnes, and Cooper in 1984, serves as the analytical tool to measure the relative efficiency of units in minimizing input usage.

The Key findings from this study include:

The COVID-19 pandemic poses a significant threat to human life and impacts various sectors, with economic repercussions being particularly pronounced. The daily mortality rate globally underscores the severity of the virus.

this study provides a comprehensive evaluation of the efficiency of Arab countries in combating the COVID-19 pandemic in April 2020, employing a robust DEA framework with the BCC model. The results offer valuable insights into the effectiveness of national strategies in mitigating the pandemic's impact, particularly in terms of resource utilization and economic resilience.

- The results of efficiency calculation indicate that Libya, Saudi Arabia, Bahrain are the countries with full efficiency in contagion control that can be looked upon for control COVID-19 contagion.

- United Arab Emirates achieved efficiency during the first period but declined during the second period.

- Egypt achieved the least efficiency rat compared to other Arab countries.

- Mauritania is in a different case from all other countries, In this country, the average contagion rate low for April.

- Qatar, Sudan, Morocco, Algeria, Tunisia, Kuwait, Jordan, and Oman have experienced inefficient in prevent COVID-19 contagion.

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