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Research Article

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Lockdown and Economic Recovery Policies During Coronavirus Pandemic: A Comparison Between Selected Countries

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Abstract

Covid-19 has caused significant damages to the economy of countries. Although economic losses are not limited to growth slowdown, the index of these losses can be considered an economic growth decrease. In the statistics presented in this article, we will see how countries faced negative economic growth during different seasons of 2020. As governments experienced Covid-19 in their country, they faced two primary occurs uncertainty about declining economic activity and Concerns about the collapse of the healthcare system. Then, governments have been forced to control the rate of spread through restrictions and lockdown while implementing economic stimulus policies. Therefore, the question of the present study is which countries have acted more efficiently in the simultaneous implementation of quarantine policy and economic recovery? This paper uses four indicators in 105 countries during 2020: "Covid-19 economic stimulus Index" (CESI)," stringency Index" (SI) as a measure of lockdown, "economic growth rate", and "per capita mortality rate of Covid-19 ". Using DEAP software and with the DEA method, performance scores were calculated. We find that the research hypothesis cannot be rejected: the greater the scope of economic recovery or the smaller the Lockdown scale in a country, it does not necessarily lead to greater efficiency in reconstructing that economy. To know why more information is needed about the nature and function of the coronavirus. The conclusion of this paper that the return to pre-corona economic activity could not be due to efforts to control mortality and economic recovery suggests a path for future studies.

Keywords: Lockdown Policy; Economic Recovery Policy; Coronavirus Pandemic; Economic Stimulus Index.

Introduction

Chinese officials announced that 59 people had an unknown illness with flu-like symptoms in early January 2019. About a month later, it was announced that this unknown disease had similarities to the Corona-SARS 2002, which is why it was named Coronavirus 2019 or Covid 19. It is now known that the first case of Covid 19 occurred on November 17, 2019, in Hubei Province, Wuhan City, China. The virus has spread to 199 countries, and as of this writing, 2.3 percent of the world's population has been infected with coronavirus, and about 0.05 percent of the world's population has died from the disease [1].

In addition to the damage that the virus has done to human health, it has also caused significant damages to the economy of countries. The extent of the damage cannot be calculated due to both the extent and the diversity; but unemployment increasing, worsening income distribution, reduced labour productivity, and reduced educated human capital are examples . Although economic losses are not limited to growth slowdown , the index of these losses can be considered an economic growth decrease. In the statistics presented in this article, we will see how countries (one after another) faced negative economic growth during different seasons of 2020. In addition to infection of some of the labour force and losing hours of work capacity, decreasing economic growth is also due to precautionary policies (such as general lockdown). However, statistics will also show that countries' economic growth will be revived in almost the same decline order. This revival is due to economic policies that governments have adopted to address the harmful effects of health controls on the economy and the maintenance of public welfare [2].

Thus, almost all Covid-19 policies fall into two general categories:

public lockdown and economic stimulus [3]. Lockdown policies refer to any policy that prevents the accumulation of individuals and speeds up the transmission of the virus. Thus, Lockdown policies range from travel bans to business closures. On the other hand, economic stimulus policies are a set of policies that are implemented to prevent the permanent closure of economic activities. Economic stimulus policies, then, can range from transfer payments to corona-damaged businesses to expansionary monetary, fiscal, and exchange rate policies.

Parts of these policies may interact positively or negatively with each other. For example, a temporary reduction in the tax rate (as a policy of economic stimulus) will encourage production, which is not in line with the Lockdown policy. Nevertheless, for example, the payment of subsistence allowances to workers between the time of illness and their recovery is compatible with the Lockdown policy [4]. Therefore, depending on the composition of policies, the efficiency of their simultaneous implementation is different in countries.

Therefore, the question of the present study is which countries have acted more efficiently in the simultaneous implementation of quarantine policy and economic recovery? The more significant economic stimulus or, the smaller the scale of lockdown in a country can not necessarily lead to greater efficiency in the recovery of that economy.

To verify this hypothesis, this paper uses four indicators in 105 countries, during 2020: "Covid-19 economic stimulus Index" (CESI)," stringency Index" (SI) as a measure of lockdown, "economic growth rate", and "per capita mortality rate of Covid-19 ". Furthermore, the research method for determining the efficiency scores of countries will be data envelopment analysis (DEA).

This article is structured as follows: The theoretical framework of epidemiological economics is introduced in the second section. Also, the indicators mentioned in the above lines are introduced in detail, and the research methodology is expressed. Experimental results are presented in the third section, and finally, the article will end with a Discussion and conclusion in the Fourth and fifth sections respectively .

Methods

Theoretical framework

Keynesian economics cover theories of the recession. So, to avoid duplication, only the theoretical framework of the Lockdown policy is stated in this section.

Each model of an epidemic is usually represented by letters that indicate the type of model. The "SI model" (sometimes called the simple epidemic model), For example, is a model in which any susceptible person (S) will never recover (R) if they are Infected (I). However, in the "SIS model", infected people will be recovered and are still susceptive to infection (e.g. gonorrhea). In the "SIR model", infected people will be recovered and become safe; That is, they do not become Infected again (for example, measles or the flu). The "SEIR model" is the same as the previous model, except that the disease has a Latent (or Exposed) period (E). Information about Covid-19 is not yet conclusive. For example, we do not know whether people who have recovered will become infected again or not. So, we have to assume that the recovered are immune (or at least immune for a while, or maybe infected with other mutations in the virus). For this reason, we consider the Covid-19 epidemic as an SIR model.

Suppose that, St People are susceptible to Covid, at time t; It people affected, Rt is the number of people improved, and N is the size of the population .so:

$$N_t = S_t + I_t + R_t$$

If we divide the number of these three groups by N:

$$1 = s_t + i_t + r_t$$

s_t is the percentage of susceptible individuals of the total population, i_t is the percentage of infected individuals, and r_t is the percentage of improved individuals.

When a susceptible person is in contact with an infected person, everyone in the susceptible group can become infected and go into the infected group. The contact variable varies in different diseases. In the case of Covid-19, contact means bringing people closer together so that the disease is transmitted through breathing. In addition, being in contact with a sick person does not necessarily guarantee to get sick. Let α show the probability of infection to Covid-19 due to contact with an infected person.

In period 0, we have I_0. This is called the initial state of the system. Assume that each infected person is in contact with γ healthy person at any given time. Therefore, the number of potential new patients is γI_0. However, as mentioned, not all contacts lead to disease transmission. Therefore, each infected person can develop αγ new infection at any time. We show this value as β. B is the average number of possible transmissions from an infected person in each period. So, in any period, an infected person can develop βst new case. We also assume that k percent of patients will be recovered.

Now we need a set of differential equations to show the dynamics of the system. Due to the transmission of the disease, βstIt person decreased from group "s", in each period; for this reason, we have in period t + 1:

$$S_{t+1} = S_t - \beta S_t I_t$$

Also, the equation for the recovered is:

$$R_{t+1} = R_t + kI_t$$

In each period, k percent of an infected person recovered and fell into the "R" group.

Finally, the changes in the population of the affected group in each period increase as new cases rise and decrease as the number of recovered in each period:

$$I_{t+1}=I_t+\beta S_t I_t-kI_t=I_t(1+\beta S_{t-k})$$

Of course, each of these three equations can be written in terms of proportional variables:

$$s_{t+1} = s_t-\beta s_t i_t$$
$$r_{t+1} = r_t+ki_t$$
$$i_{t+1}=i_t(1+\beta s_{t-k})$$

With the constrain that

$$s_{t+1}+i_{t+1}+r_{t+1}=s_t+i_t+r_t=1$$

As long as $i_{t+1} > i_t$, we are above the epidemic threshold, and the number of infections will increase. This means$\beta S_t>k$. The parameter k is a function of biological and physiological characteristics of individuals and is in the field of specialization of physicians and medical researchers. However, β is the function of the social behavior of the population and can be controlled. It may be recommended, for example, that sick children and workers stay at home so that others stay less infected. Therefore, people can be quarantined as long as there is a Coved-19 pandemic.

Data

Covid-19 economic stimulus Index (CESI)

The CESI Index is designed by Elgin et al. to measure how countries succeed in economic stimulus [5]. The information needed to calculate this index is collected from the IMF COVID19 policy tracker (2020). This information is classified into three general categories: 1) fiscal policies, 2) monetary policies and 3) policies related to the foreign sector of the economy.

This index varies between +5 (highest measures for economic recovery) to -5 (lowest measures for economic recovery). The descriptive statistics of this index are summarized in Table (1).

Table (1): descriptive statistics of research variables

	CESI	SI	GDP Growth	Fiscal Policy	Monetary Policy	Microfinance	Per capita mortality
average	0.27	52.54	-3.78	6.53	26.17	7.97	0.07
variance	2.02	268.40	18.50	44.70	761.63	125.48	0.01
max	Bahrain	Sri Lanka	Ethiopia	Japan	USA and Norway	Italy	Peru
min	Algeria	Nicaragua	Lebanon	Oman	Many countries	Many countries	Tanzania

Source: research considerations

As Table (1) shows, the average score of CESI for 105 countries in the present study is 0.27; the highest of it is related to Bahrain, and the lowest attempt to revive the economy is made to Algeria.

"stringency Index" (SI)

Hale et al. collected available data on governments' responses to controlling the Covid-19 epidemic [6]. These reactions include school closings, travel restrictions, bans on public gatherings, etc. then, they record data on a numerical scale. This number is presented in the form of an astringency index, which will be referred to as a Lockdown index in the continuation of the article. The descriptive statistics of this index are summarized in Table (1).

The average for this index for 105 countries is 52.5. The highest implementation of the Lockdown policy is in Sri Lanka and the lowest in Nicaragua.

Research methodology

As mentioned in the introduction, our research question is which countries have acted more efficiently in the simultaneous implementation of the Lockdown policy and economic recovery? The research hypothesis is that a more significant economic stimulus or the smaller the scale of lockdown in a country can not necessarily lead to greater efficiency in the recovery of that economy. In other words, on the one hand, countries with stricter Lockdown policies have reduced their economic activity; On the other hand, some countries have taken more steps to return the economy to its former state of Corona. However, neither of these two countries can necessarily do better. Because, as has been said, recovery and Lockdown policies are not mutually exclusive: one reduces economic growth, and the other stimulates it. For this reason, the greater efficiency of a country in economic reconstruction should be considered in conjunction with the success of that country in controlling the spread of disease. The four indicators of CESI, SI, G (economic growth rate) and M (per capita Covid-19 mortality) in 105 countries during 2020 will be used to test this hypothesis.

Since several input and output variables have been studied simultaneously, this study examines performance in a multifactorial manner, and therefore we need a method that calculates performance scores in a multidimensional way. This method is Data Envelopment Analysis (DEA) technique.

Data Envelopment Analysis is a non-parametric statistical method founded by Charnes et al. based on linear programming technique [7]. It is used to empirically measure the productive efficiency of decision-making units (DMUs). DEA is one of the most widely used methods in calculating economic efficiency [8]. Figure (1) shows the conceptual model of this method for the current study.

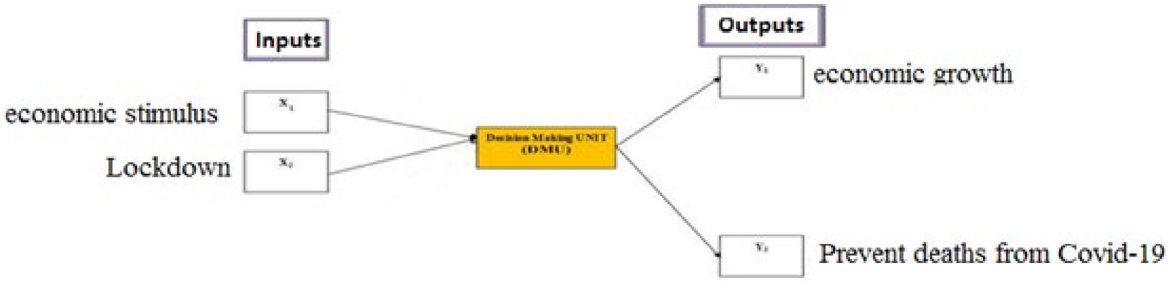

Figure (1): a conceptual model of study
Source: research considerations

DEA method has the weakness that it cannot calculate performance scores for negative data. To solve this problem, it is enough to select the least negative value between the DMUs and then add its absolute value to all the data; in this way, performance ratings are calculated correctly with positive data [9].

Results

The economic stimulus index, Lockdown index, economic growth and per capita mortality due to Covide-19 (which is entered into the model as a minus from one) were examined for 199 countries. Since there were some missing data for each variable, 105 DMUs (countries) was finally selected. Data with negative values changed to positive ones by Pastor and Ruiz (2007) method [9]. Then, Using DEAP software and with two assumptions about the DEA method, performance scores were calculated: Assumption 1) The method of calculating the efficiency is the output Orientated, 2) fixed return to the scale (CRS) and again a variable return to the scale (VRS).

The fact that the method of calculating efficiency is output Orientated means that the criterion of higher efficiency scores should be given to countries with more output (i.e. more economic growth while preventing more mortality). Contrary to this assumption, there is an input Orientated method in which high-efficiency scores are awarded to countries that have achieved a consistent result with the least effort to lockdown and economic recovery. Therefore, it is natural that conceptually, the countries that are successful in economic recovery are the ones that have obtained the highest efficiency scores by the output-oriented method.
The assumption of returns to scale is also a long-term concept that reflects the ratio of output increased to increase in inputs. Fixed returns scale is accurate when an increase in input increases output in the same proportion. Ascending return to scale means that the output increased more relative to the rate of increase in inputs. If the rate of output increase is less than the rate at which inputs increase, a downward return to scale is created.

As shown in the appendix, the worst relative efficiency scores are in Bahrain and the best in Algeria, Tanzania and Nicaragua. Note that while there has been a double effort to stimulate Bahrain's economy compared to Algeria, they have almost the same economic growth rate. Therefore, despite efforts to revive the economy, as Bahrain has fewer health protocols, the per capita mortality rate is higher than in Algeria. This has reduced the efficiency score of Bahrain. To better understand the comparisons, we classify 105 countries into five groups as described in Table (2).

Table (2): Efficiency Score in 5 groups of countries

Efficiency	Fiscal Policy	Monetary Policy	Macrofinance	CESI	SI	Economic Growth	Per capita Mortality	Efficiency Score
Very High	2.538	16.190	1.662	-0.932	34.105	-0.695	0.043	0.740
High	4.776	25.019	4.586	-0.346	51.608	-2.635	0.075	0.564
Medium	6.810	29.895	3.757	-0.101	58.994	-2.995	0.068	0.494
low	6.990	21.219	8.124	0.366	60.163	-7.191	0.055	0.450
Very low	11.543	38.538	21.743	2.353	57.826	-5.403	0.104	0.368

Source: research considerations

Discussion

As can be seen, with decreasing average efficiency scores, economic growth and per capita death from disease (as model outputs) worsen. The more the economic recovery effort and the stricter the lockdown (as model input), the lower the efficiency scores of countries. In other words, the more economic stimulus does not necessarily lead to greater relative efficiency. Also, stricter lockdown does not necessarily make greater relative efficiency. This means that the research hypothesis cannot be rejected. As governments experienced Covid-19 in their country, they faced two major occurs uncertainty about the future (declining economic activity) and Concerns about the collapse of the healthcare system. Then, governments have been forced to control the rate of spread through restrictions and lockdown while implementing economic stimulus policies. As can be seen, with decreasing average performance scores, economic growth and per capita mortality from disease (as model's outputs) worsen. The more stringent economic recovery and Lockdown efforts (as input to the model), the lower the efficiency scores of countries in resuming economic activity. In other words, countries that have made more efforts to revive their economies do not necessarily have greater relative efficiency in recovering their economies. Also, stricter lockdown does not necessarily mean greater relative efficiency in returning to economic activity. This means that the research hypothesis cannot be rejected: the more significant the scope of economic recovery or the smaller the Lockdown scale in a country, it does not necessarily lead to greater efficiency in reconstructing that economy [10-12].

Conclusion

As mentioned above, the more significant the scope of economic recovery or the smaller the Lockdown scale in a country, it does not necessarily lead to greater efficiency in reconstructing that economy. To know why more information is needed about the nature and function of the coronavirus. For example, it may be seen in the future that the control of mortality from this disease depends more on the genetics of individuals in different geographical areas than on environmental factors (such as economics or lockdown). If so, then control of corona mortality will not be due to Lockdown efforts (at least not all) and will depend on biological issues. Although such a possibility is unlikely, new findings on the nature of the coronavirus will reveal aspects of this issue. The conclusion of this paper that the return to pre-corona economic activity could not be due to efforts to control mortality and economic recovery suggests a path for future studies.

Appendix: relative Efficiency Score in selected countries

Table (2): relative Efficiency Score in world's countries

	DMUs	crste	vrste	scal		DMUs	crste	vrste	scal
1	Algeria	1	1	1	54	Gabon	0.489	0.993	0.492
2	Tanzania	1	1	1	55	Ecuador	0.432	0.88	0.491
3	Nicaragua	1	1	1	56	Japan	0.484	0.988	0.49
4	Tajikistan	0.969	1	0.969	57	South Africa	0.435	0.9	0.484
5	Ethiopia	0.892	1	0.892	58	Pakistan	0.476	0.99	0.48
6	Guinea	0.78	1	0.78	59	Poland	0.385	0.802	0.48
7	Niger	0.728	0.999	0.729	60	Albania	0.437	0.915	0.478
8	Angola	0.704	0.997	0.706	61	Vietnam	0.478	1	0.478
9	Afghanistan	0.682	0.988	0.69	62	Georgia	0.413	0.868	0.476
10	Berkinafaso	0.688	0.999	0.688	63	Azerbaijan	0.448	0.951	0.471
11	Chad	0.678	0.999	0.678	64	Finland	0.462	0.983	0.47
12	Brunei	0.671	0.999	0.671	65	Thailand	0.466	0.997	0.468
13	Palestine	0.624	0.931	0.67	66	Zimbabwe	0.461	0.988	0.467
14	Uzbekistan	0.652	0.998	0.653	67	Singapore	0.467	0.999	0.467
15	Cameroon	0.647	0.995	0.65	68	Kuwait	0.446	0.955	0.467
16	Belarus	0.614	0.967	0.635	69	China	0.466	1	0.466
17	Egypt	0.625	0.985	0.634	70	Nepal	0.45	0.97	0.464
18	Paraguay	0.519	0.826	0.628	71	Lebanon	0.409	0.885	0.463
19	Besni and Herzegovina	0.44	0.704	0.624	72	Cyprus	0.444	0.969	0.458
20	Bhutan	0.621	1	0.621	73	Spain	0.372	0.827	0.449
21	Bulgaria	0.455	0.738	0.616	74	Jamaica	0.433	0.964	0.449

22	Botswana	0.577	0.953	0.605	75	Iceland	0.441	0.991	0.445
23	Iran	0.542	0.902	0.601	76	India	0.431	0.971	0.443
24	Ghana	0.589	0.998	0.591	77	Greece	0.387	0.878	0.441
25	Nigeria	0.59	0.999	0.59	78	Estonia	0.397	0.904	0.439
26	Senegal	0.581	0.993	0.585	79	Sri Lanka	0.433	0.986	0.439
27	New Zealand	0.585	1	0.585	80	Argentina	0.345	0.796	0.433
28	Sudan	0.577	0.994	0.581	81	Saudi Arabia	0.422	0.978	0.432
29	Turkey	0.547	0.942	0.58	82	Tunisia	0.378	0.877	0.431
30	Mexico	0.474	0.821	0.577	83	Philippines	0.42	0.978	0.43
31	Togo	0.572	0.999	0.573	84	Trinidad and Tobacco	0.395	0.941	0.42
32	Uganda	0.568	0.998	0.569	85	Australia	0.408	0.997	0.409
33	Mali	0.567	0.998	0.568	86	Netherlands	0.361	0.897	0.403
34	Rwanda	0.557	0.997	0.559	87	Norway	0.396	0.986	0.401
35	Namibia	0.512	0.944	0.543	88	Italy	0.314	0.789	0.398
36	Bangladesh	0.537	0.992	0.542	89	Luxembourg	0.343	0.872	0.394
37	Pro	0.251	0.464	0.541	90	Hendros	0.366	0.931	0.393
38	Russia	0.49	0.908	0.54	91	Portugal	0.316	0.832	0.38
39	Brazil	0.404	0.76	0.531	92	United Arab Emirates	0.371	0.982	0.378
40	Novel	0.435	0.826	0.527	93	USA	0.307	0.814	0.377
41	Haiti	0.525	0.996	0.527	94	United Kingdom	0.305	0.812	0.375
42	Kazakhstan	0.507	0.977	0.519	95	Malaysia	0.369	0.985	0.375
43	Colombia	0.411	0.795	0.516	96	Belgium	0.293	0.784	0.374
44	Indonesia	0.503	0.979	0.514	97	France	0.305	0.83	0.367
45	Ukraine	0.451	0.88	0.512	98	Germany	0.32	0.891	0.359
46	Guatemala	0.484	0.95	0.509	99	Canada	0.333	0.931	0.357
47	South Korea	0.504	0.996	0.506	100	Diameter	0.34	0.979	0.347
48	Zambia	0.496	0.989	0.502	101	Malta	0.309	0.905	0.341
49	Ireland	0.452	0.902	0.501	102	Sweden	0.288	0.857	0.337
50	Madagascar	0.497	0.997	0.499	103	Oman	0.318	0.942	0.337
51	Kenya	0.495	0.993	0.498	104	Austria	0.288	0.882	0.327
52	Jordan	0.45	0.906	0.497	105	Bahrain	0.272	0.923	0.295
53	Costa Rica	0.448	0.91	0.492					

Source: research considerations

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