Heliyon 6 (2020) e05634

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

# Economic stimulus for COVID-19 pandemic and its determinants: evidence from cross-country analysis

Md. Nur Alam Siddik *

*Department of Finance and Banking, Begum Rokeya University, Rangpur 5404, Bangladesh*

ARTICLE INFO

*Keywords:*
Economic stimulus
COVID-19 cases
Fiscal policy
Multi-dimensional index
Normalized inverse Euclidean distance
Social sciences
Law
Information science
Economics
Business

ABSTRACT

Countries around the world are announcing stimulus packages in response to the COVID 19 pandemic. This research attempts to measure the extent and progress of stimulus packages by proposing a multidimensional index that standardizes governments' economic responses and allows us to examine the differences in economic policies from country to country. We apply the Euclidean distance formula to develop the new index and then identify the determinants of the economic stimulation of COVID-19 through beta-regression. The results show that Chile, Switzerland, Croatia, Sweden and the Netherlands responded more strongly to the COVID-19 pandemic, while the remaining countries responded slightly to the pandemic. Empirical results also indicate that most countries increased COVID-19 economic support, although not significantly. Finally, the results of the beta regression show that the median age of the population, the number of hospitals, beds per capita, the number of total COVID-19 cases, GDP, health care expenditure and the index of the severity of the government's response is significantly related to the level of the countries' stimulus packages.

## 1. Introduction

On 9th December of 2019 the novel coronavirus, COVID-19, pandemic emerged in Wuhan, China and has spread to 214 countries and territories causing 35,092,046 cases and 1,036,914 deaths as of October 04,2020[1]. Along with these huge human misery and loss of lives, this pandemic produced a major economic depression worldwide. The world's prevalent economies (U.S., European countries and China) are amid the ones that have been most affected by the outbreak.

The COVID-19 pandemic has direct damaging impacts on the economy in numerous ways. For example, there are border closers, stay at home requirements, lockdowns which directly affect peoples' socio-economic life. Also, disease-ridden employees who are quarantined or hospitalized cannot join the workforce, which has numerous demand and supply-side consequences. In addition, the psychological consequence of the pandemic results in extraction from economic doings by agents who chooses to espouse 'wait and see' attitude. Furthermore, measures already undertaken and still undertaking, such as lockdown, factory closures, social distancing, for flattening the contagion curve certainly steepens the macroeconomic downturn curve. These measures have been found effective in reducing the contagion rate as for example in Singapore Hong Kong and China (Anderson et al., 2020; Prem et al., 2020). Yet, these non-pharmaceutical actions hinder economic goings-on by restraining human mobility and business processes (Eichenbaum et al., 2020). Specially, the COVID-19 pandemic and allied public health measures have interrupted supply chains and contracted doings in manufacturing and service sectors, which consecutively steered to augmented layoffs. World experienced stock markets crash and the unemployment rate rose to a much higher level (Zhang et al., 2020). Zaremba, Kizys, Aharon and Demir (2020) investigated whether government interventions aimed at curbing the spread of COVID-19 affect stock market volatility. Applying data of 67 countries, authors observed that the government interventions are associated with higher stock market volatility. Authors concluded that an increase in the stringency of a government response by one index point triggers an increase in daily stock market volatility. Mentioning that no preceding infectious disease outbreak, including the Spanish Flu, has affected the stock market as forcefully as the COVID-19 pandemic, Baker et al. (2020) focused on the causes that drove the tremendous recent surge in stock market volatility. Employing U.S. stock market data and COVID-19 relating data, authors found that government restrictions on commercial activity and voluntary social distancing, operating with powerful effects in a

* Corresponding author.
*E-mail address:* nasiddikbru@gmail.com.

[1] https://www.worldometers.info/coronavirus/countries-where-coronavirus-has-spread/.

https://doi.org/10.1016/j.heliyon.2020.e05634
Received 23 May 2020; Received in revised form 6 October 2020; Accepted 27 November 2020

service-oriented economy, are the main reasons the U.S. stock market reacted heavily to COVID-19. In a similar study, Albuquerque et al. (2020) contended that COVID-19 pandemic shows an unparalleled tremor to the stock market. According to authors, this is because of firstly, the COVID-19 crisis and the succeeding economic lockdown is an unanticipated shock to global stock markets. Secondly, it is an exogenous shock that coined out of public health concerns, not for economic circumstances and thirdly, the pandemic resulted in a stock market crash.

Thus, it is inevitable to mitigate the negative effects of COVID-19 pandemic on economy. Countries poured down trillions of dollars in stimulus packages to save their economy and livelihood. Covid-19 economic stimulus packages refers to the key economic responses governments are taking across the world to limit the human and economic impact of the COVID-19 pandemic. Governments across the world have undertaken several stimulus packages including fiscal, and monetary measures targeting households, health care, and manufacturing and servicing industries (Bayer et al., 2020; Cheng et al., 2020; Gourinchas, 2020) and there is variation between the responses provided by different national governments to the COVID-19 pandemic (Capano et al., 2020). In response to COVID-19 pandemic, monetary policy responses undertaken by countries includes to liquidity support to banks. Archetypal fiscal policies contain allocations to households and businesses entities, costs of temporary layoffs, increase of social safety assistances, and resources for the countries' healthcare system. For instance, South Korea announced cash transfers for isolated persons, consumption tokens for low-income families, and income and rental support for small and medium-sized businesses. Germany enlarged entrance to temporary work subsidy, improved childcare welfares for low-income parentages, and delivered grants to small and medium business proprietors who were affected by the pandemic. United Kingdom, the 2nd highest death facing countries, upto 6 May, total death of U.K is 30,076[2], delivered much funding for their National Health Service, took measures to assist businesses operations, direct donations for small business, and reimbursement for sick pay leave, and fortified the social safety net to assist helpless individuals (International Monetary Fund, 2020).

In this research, we review diverse economic policy measures undertaken by policymakers and governments of countries as a response to COVID-19 pandemic which consists of mostly fiscal, monetary and exchange rate measures. We argue that no single stimulus would be able to dampen the destructive effects of a pandemic and a collective measures are needed. Thus, using the Euclidean distance (EI) method, we develop an Index of COVID-19 Economic Stimulus (ICES) which pooled all undertaken fiscal, monetary, and exchange rate measures. This index systematizes the economic policy responses undertaken by governments across the world, thus permits to study cross-country differences in strategies and policies. In addition, we explore to what level countries' economic responses are formed by numerous country features, pandemic-related variables and public health measures (Correia et al., 2020). The contributions of the study is manifold. First, we develop a new composite index to measure economic policy responses to COVID-19 pandemic. Second, this study would contribute to its field by adding literatures of the measurement issues of stimulus index. Third, this robust and composite index can be applied by policy makers to see their state of affairs allied to COVID-19 pandemic; can be helpful for policy making process and to keep an eye on the improvement of the policy programs undertaken to combat economic downturn.

Countries across the world have adopted a number of economic policies in response to COVID-19 pandemic (Hale, Petherick, Phillips and Webster, 2020). For example, transfer of cash to households, subsidies to business and so on. We argue that no single measure is enough to reduce the effect of a pandemic. A single indicator might provide useful information on a single aspect of any issue but might produce contradictory results when combining them together (Sarma, 2015). To avoid such contradictory results, Sarma (2015) proposed a comprehensive index of financial inclusion that encompasses different indicators of financial development. Arguing similar with Sarma (2015), an index of economic stimulus packages is needed, first of all, to avoid contradictory results. For example, as a response to COVID-19 pandemic, a country might provide more stimuli to health sector while overlooked or has less emphasis on other economic sectors including business and poor households. Result from such policy might be contradictory. As such we focus on developing a composite Index of COVID-19 economic stimulus which will enable respective country's government to monitor their policy effectiveness as a whole. The foremost advantage of such composite index is that it yields a single value for every nation or area and thus one can spot the standing of a specific country or region of interest and then compare it with any other countries or regions straightforwardly while data on several indicators might become a big issue.

With an attempt to fill these gaps, the objective of this research is to develop a comprehensive index of COVID-19 Economic Stimulus and thereby measures the extent of economic responses taken by governments. Also, this research intended to empirically identify and analyze the determinants of economic stimulus undertaken in response to COVID-19 pandemic.

## 2. Methodology

### 2.1. Construction of the proposed index

To construct the current comprehensive stimulus index, we employed similar methods applied by United Nation Development Programme to develop such indices as Human Development Index (HDI)[3]. At the first step, value of dimension index for the $i^{\text{th}}$ dimension $d_i$ is computed as under:

$$d_i = \frac{(A_i - m_i)}{(M_i - m_i)} \tag{1}$$

In Eq. (1), $d_i$ is value of $i^{\text{th}}$ dimension index; $A_i$ is real value of $i^{\text{th}}$ dimension; $m_i$ is minimum value of $i^{\text{th}}$ dimension, and $M_i$ is maximum value of $i^{\text{th}}$ dimension. Eq. (1) ensures $0 \le d_i \le 1$. Accordingly, in Eq. (1), the higher the value of $d_i$, the higher the country's policy response in dimension *i*. For n dimensions of policy response, a particular country *i* will be denoted by a point $D_i = (d_1, d_2, d_3 \ldots d_n)$ on n-dimensional Cartesian space. In the n-dimensional space, the point $O = (0,0,0,\ldots0)$ stand for the point representing the worst situation while the point $I = (1,1,1,\ldots,1)$ stand for the highest response in all dimensions.

Statistically, the Euclidean distance, also known as the Euclidean metric is the simple distance between two points that one would calculate with a ruler and is given by the renowned Pythagorean method (i. e. $A^2 = B^2 + C^2$). Using Pythagorean equation, the Euclidean distance between two points (x and y) is line segment linking them ($\overline{xy}$). In Cartesian coordinates, if $x=(x_1, x_2, x_3 \ldots x_n)$ and $y=(y_1, y_2, y_3 \ldots y_n)$ are two points in Euclidean n space, then we can calculate the distance (d) between this two points as under:

$$d(x,y) = d(y,x) = \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2 + \ldots + (x_n - y_n)^2}$$

$$d(x,y) = d(y,x) = \sqrt{\sum_{i=1}^{n} (x_i - y_i)^2} \tag{2}$$

Eq. (2) explains that in single dimension, the absolute arithmetical difference is simply the distance between two points x and y. In this case,

[2] https://www.worldometers.info/coronavirus/countries-where-coronavirus-has-spread/.

[3] For details of HDI, please see Technical Note in UNDP's Human Development Reports available at www.undp.org.

$$\sqrt{(x-y)^2} = |x-y| \tag{3}$$

The two dimensional Euclidean distance for x=(x1, x2) and y=(y1, y2) is then equal to the Pythagorean formula and is described as under:

In Figure 1, the squared length of a vector $x = [\,x_1\, x_2\,]$ is the sum of the squares of its coordinates ($|OL|^2$ is signified by the distance between points O and L and the squared distance between two vectors $x = [\,x_1\, x_2\,]$ and $y = [\,y_1\, y_2\,]$is the sum of squared differences in their coordinates. As shown in Figure 1, $|LM|^2$ is the distance between points L and M. Therefore, distance between vector x and y can be computed as follows:

$$d^2(x,y) = (x_1-y_1)^2 + (x_2-y_2)^2 \tag{4}$$

Where $d2\ (x,y)$ denotes to the distance between vectors x and y. Now, taking square root of each side,

$$d(x,y) = \sqrt{(x_1-y_1)^2 + (x_2-y_2)^2} \tag{5}$$

This two dimensional theorem can be extended to vectors with three dimensional point $\mathbf{x} = [\,x_1\, x_2\, x_3]$ and $\mathbf{y} = [\,y_1\, y_2\, y_2]$. To do the same, first we consider following Figure 2 as a room where corner point 'O' stands for the origin. Three coordinates are symbolized by points A, B and C along the Axis 1, Axis 2 and Axis 3 respectively and $90^{\circ}$ angles AOB, AOC and COB. Now, we can employ Pythagoras' theorem as under:

$$|OL|^2 = |OE|^2 + |LE|^2 \qquad |OE|^2 = |OA|^2 + |AE|^2$$

We apply Pythagoras' theorem twice since for $|OL|^2$it is right angled at point 'E' and for $|OE|^2$ it is right angled at point 'A'. Thus, from Figure 2 we can write

$$|OL|^2 = |OA|^2 + |AE|^2 + |LE|^2$$

Thus, we see squared length of '**x**' is the sum of its three squared coordinates and thus

$$d_x = \sqrt{x_1{}^2 + x_2{}^2 + x_3{}^2}$$

Now, in Figure 2, if we place a point, say 'M' to represent another vector 'y', this will enable us to calculate the distance between x and y as under:

$$d(x,y) = \sqrt{(x_1-y_1)^2 + (x_2-y_2)^2 + (x_3-y_3)^2} \tag{6}$$

Which follows that in general, for n-dimension, the Euclidean distance could be calculated as under:

$$d(x,y) = \sqrt{(x_1-y_1)^2 + (x_2-y_2)^2 + \ldots + (x_n-y_n)^2} \tag{7}$$

This Eq. (7) is equivalent to Eq. (2). Now, we apply Displaced Ideal (DI) technique recommended by Zelany (1974). DI technique assumes that the lower the distance from the ideal point, the improved the performance of a system. Usually the ideal point is 1.00 and in our proposed index the ideal point is also 1.00 which indicates complete economic stimulus. Applying Displaced Ideal (DI) method we proceed as follows:

$$D_n = \sqrt{(1-\mathrm{d}_1)^2 + (1-\mathrm{d}_2)^2 + \ldots + (1-\mathrm{d}_n)^2} \tag{8}$$

Employing normalized inverse Euclidean distance of the point $D_i$ from the ideal point I= (1, 1, 1….1), the Index of Economic Stimulus, $IES_i$ for the $i^{th}$ country, then, is computed as follows:

$$ICES_i = 1 - \frac{\sqrt{(1-\mathrm{d}_1)^2 + (1-\mathrm{d}_2)^2 + \ldots + (1-\mathrm{d}_n)^2}}{\sqrt{\mathrm{n}}} \tag{9}$$

In above Eq. (9), the inverse normalized distance is observed by normalizing the Euclidean distance of Di from the ideal point I, the numerator of the second component, by n and then subtracting by 1. The aim of normalization is to make sure the value lie between 0 and 1 and the inverse distance is calculated to mirror that the upper value of the ICES refers to higher economic stimulus.

Alternatively, there are other methods of constructing an index. One of those methods is construction of index based on principal component analysis. Principal component Analysis, PCA, is a multivariate statistical technique applied to decrease the number of variables in a data set into a lesser number of 'dimensions'. In mathematical terms, from an initial set of n correlated variables, PCA forms uncorrelated indices, where each component is a linear weighted mixture of the initial variables. The weightiness for every principal component are given by the eigenvectors of the correlation matrix, or the co-variance matrix. The components are ordered in such a way so that the first component, PC1, describes the biggest likely amount of variation in the main data. The next component, PC2, is absolutely uncorrelated with the first component, and elucidates added but less variation than the PC1. Successive components are uncorrelated with preceding components; consequently, every component captures an added dimension in the data, while explaining lesser and lesser magnitudes of the variation of the original variables. However, PCA methods has some issues that must be taken into account. First of all, index based on PCA is often elitist with a solid propensity to represent extremely inter-correlated indicators and to disregard the others. So many highly imperative but poorly inter-correlated indicators may not be considered by the composite index. Secondly, PCA is a recklessly pragmatist technique based on the correlations and it overlooks the divergence of the distinct indicators. Thirdly, the amount of variance accounted for, and the weightiness calculated by PCA change over time. Thus, the outcomes of different PCAs are not straightforwardly analogous (Vyas and Kumaranayake, 2006).

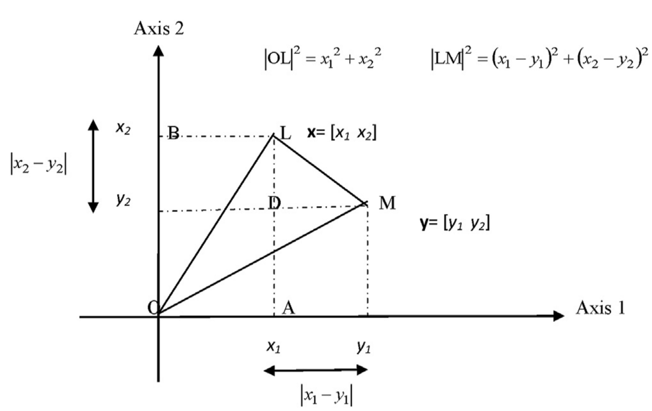


Figure 1. Application of Pythagoras' theorem into two dimensional spaces.

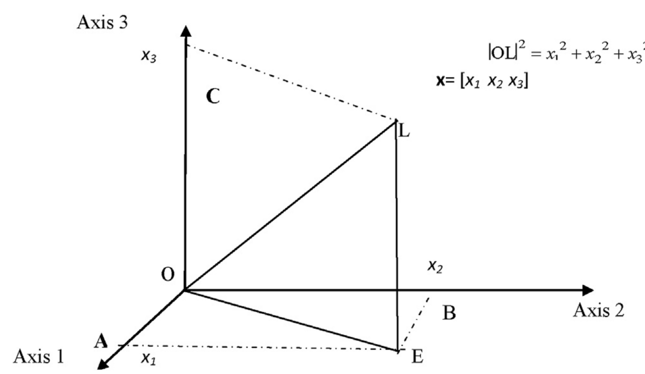


Figure 2. Application of Pythagoras' theorem into three dimensional spaces.

### 2.2. Proposed index of COVID-19 economic stimulus (ICES)

A composite and robust stimulus index should comprise as many dimensions as conceivable; the index should be easy and simple to compute and should be comparable across countries or regions (Sarma, 2015). To develop the present economic stimulus index, based on availability of data, we consider three dimensions of economic stimulus: fiscal policy, monetary policy and exchange rate policy as presented in Table 1. We assigned equal weight to each indicator and each dimension on the argument that the variables considered to develop the proposed index in pandemic situations all stimulus are equally important.

Therefore, considering the above explained dimensions – Fiscal policy, Monetary policy and Balance of payment/Exchange rate policy –The ICES value for the country $i$ is measured by the normalized inverse Euclidean distance of the point ($f_i$, $m_i$ $e_i$) from the ideal point (1, 1, 1). Mathematically,

$$ICES_i = 1 - \sqrt{\frac{(1-f_i)^2 + (1-m_i)^2 + (1-e_i)^2}{3}} \tag{10}$$

The proposed Index theoretically takes values between Zero (0) and one (1). The value zero could be described as the status of 'no economic stimulus' and the value 1 as 'complete economic stimulus'. For analytical purpose, following the work of (Sarma, 2015) and recognizing the importance of economic policy response to pandemic situations of present world, countries are given categories of low response to COVID-19 group, medium response to COVID-19 group and high response to COVID-19 group depending on their ICES values which is presented in Table 2.

### 2.3. How the proposed index is unique

Our formula to calculate dimension index (Eq. 1) is similar to the procedure applied in developing HDI. However, we contrast from HDI in that we apply empirically observed minimum and maximum values while HDI applies pre-determined values for maximum and minimum. In the second step, instead of considering geometric mean (as employed in the last stage of HDI index), we employ Displaced Ideal (DI) technique advised by (Zelany, 1974).

Proposed index is different from Elgin et al. (2020) where authors applied principal component analysis to calculate the weight of the dimension value. By assigning differentiated weight to different dimension, authors ignores the real importance of every single stimulus in times global pandemics. Ignoring the equal importance to a stimulus might produce multiplicative complexities. Also, authors produce negative value of stimulus index, though not explained what it implies. Thus, we employed Euclidean distance formula so that any economic stimulus could take positive value.

### 2.4. Data sources

In order to determine the extent of economic stimulus for COVID-19 in all 168 countries, the present study gathered and used monthly data from June, 2020 to September, 2020 available from the International Monetary Fund (IMF COVID-19 Policy Tracker, 2020). This policy response tracker focuses on discretionary actions and might not fully reflect the policies taken by countries in response to COVID-19, such as automatic insurance mechanisms and existing social safety nets which differ across countries in their breadth and scope. Besides economic policy measures mentioned and explained in Table 1, we further examine the extent to which countries' economic responses are shaped by numerous country features, COVID-19 allied variables and public health measures. Using different sources, we gathered data on public health measures and pandemic-related variables. We gathered data on median age of countries in 2019. We also considered number of hospital beds per 1000 people, current health expenditure of countries as a ratio of GDP and collected data from World Bank and data on COVID-19 Government Response Stringency Index of (Hale, Webster, Petherick, Phillips and Kira 2020) has been collected.

## 3. Results and discussion

### 3.1. Descriptive statistics

Table 3 shows the descriptive statistics of economic variables used in this study along with the index of COVID-19 economic stimulus (ICES). According to Table 3, on average countries have undertaken economic stimulus packages of 0.24 herein referred as low stated, with a minimum of 0.05 and maximum of 0.49 with a standard deviation of 0.09. We find on average 5.38% fiscal policy measures have been undertaken by countries where maximum is 42.20% and minimum is 5% and a standard deviation of 5.82%. In case of interest rate cut, we observe a mean value of 13.01 with a higher standard deviation of 26.52. This is evident as because there are 168 countries with significant interest rate cuts. In response to COVID-19, countries undertook macro-financial packages of 5.41% of GDP where we find the maximum 49.98% and minimum 0.00 along with a standard deviation of 8.30%. This is because a number of countries have not yet adopted adequate macro-financial packages. In case of other BOP measures, we find a mean value of 0.29 with a maximum value of 1.00.

### 3.2. Status and progress of economic policy responses to COVID-19

Table 6, provided in appendix, exhibits results of computed ICES values for the four months along with country rank and status separately in response to COVID-19 over the period of June, 2020 to September, 2020 where $ICES_1$ is the index value of COVID-19 Economic Stimulus in the month of June, 2020; $ICES_2$ is the index value of COVID-19 Economic Stimulus in July, 2020; $ICES_3$ is the index value of COVID-19 Economic Stimulus in August, 2020 and $ICES_4$ is the index value of COVID-19 Economic Stimulus in September, 2020.

According to findings provided in Table 6, across all countries, in June, 2020, 70 countries' response was medium level where Switzerland, Croatia, Thailand, Slovenia, and Chile's policy response to COVID-19 pandemic ranked 1$^{st}$, 2$^{nd}$, 3$^{rd}$, 4$^{th}$ and 5$^{th}$ respectively and 98 countries response was low level. In the month of July, 2020, Chile's policy response to COVID-19 pandemic was high and Croatia, Switzerland, Sweden and Netherland have improved economic policy response to

**Table 1.** ICES: Dimensions, indicators and data sources.

| Dimension | Indicators | Source of data |
|---|---|---|
| Fiscal policy | All the adopted fiscal measures (as a proportion of GDP) | International Monetary Fund (2020) |
| Monetary policy | Interest rate cut by the monetary policy authority (percentage of the ongoing rate) | International Monetary Fund (2020) |
| | The size of the macro-financial package (percentage of GDP) | International Monetary Fund (2020) |
| | Reserve requirement | International Monetary Fund (2020) |
| Balance of payment/Exchange rate policy | Specific BoP measures coded as a percentage of GDP | International Monetary Fund (2020) |
| | A dummy variable taking the value of 1 if there are other reported measures and 0, otherwise | International Monetary Fund (2020) |

**Source:** Prepared by the author

**Table 2.** Grades for economic policy response to COVID-19.

| Value of Index of COVID19 Economic Stimulus (ICES) | Policy Response Grade |
|---|---|
| 0 < ICES≤0.25 | Low response to COVID-19 |
| 0.25 < ICES ≤0.5 | Medium response to COVID-19 |
| 0.5 < ICES ≤1 | High response to COVID-19 |

**Source:** Proposed by the author

**Table 3.** Descriptive statistics.

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Index of COVID-19 Economic Stimulus | 168 | 0.24 | 0.09 | 0.05 | 0.49 |
| Fiscal Policy Measures (% of GDP) | 168 | 5.38 | 5.82 | 5.00 | 42.20 |
| Interest Rate Cut (%) | 168 | 13.01 | 26.52 | -28.33 | 100.00 |
| Macro-financial package (% of GDP) | 168 | 5.41 | 8.30 | 0.00 | 49.98 |
| Reserve Requirement and Buffer | 168 | 21.13 | 33.94 | 0.00 | 150.00 |
| BOP Measures (% of GDP) | 168 | 0.67 | 2.10 | 0.00 | 14.55 |
| Other BOP Measure (0–1 dummy) | 168 | 0.29 | | 0.00 | 1.00 |

**Source:** Author's computations

**Table 4.** Correlation matrix.

| | ICES | Median age | Hospital bed | Total cases | GDP | Health expense | Stringency Index |
|---|---|---|---|---|---|---|---|
| ICES | 1.000 | | | | | | |
| Median age | 0.375** | 1.000 | | | | | |
| Hospital bed | -0.165** | 0.014 | 1.000 | | | | |
| Total cases | 0.197** | 0.176 | 0.114 | 1.000 | | | |
| GDP | 0.237** | 0.206 | 0.239 | 0.280 | 1.000 | | |
| Health expense | 0.142** | 0.210 | 0.113 | 0.115 | 0.458* | 1.000 | |
| Stringency Index | 0.118** | 0.069 | 0.105 | -0.089 | -0.056 | -0.106 | 1.000 |

**Note:** ** and * denotes significant at 5% and 10% level of significance respectively.
**Source:** Author's computations

**Table 5.** Results of beta regression and marginal effects.

| Variable | Coefficient | Standard error | Marginal effects (dy/dx) | Standard error |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| Median age | 0.030*** | 0.009 | 0.0048 | 0.001 |
| Hospital beds | -0.039* | 0.004 | -0.0071 | 0.004 |
| Total Cases (per million population) | 0.004* | 0.006 | 0.0010 | 0.006 |
| GDP per-capita (000 US dollar) | 0.227** | 0.180 | 0.1005 | 0.003 |
| Health expense (%of GDP) | 0.291* | 0.160 | 0.1140 | 0.001 |
| COVID-19 Government Response Stringency Index | 0.002** | 0.001 | 0.0008 | 0.006 |
| Constant | -1.472*** | 0.339 | 0.2440 | 0.007 |
| Number of obs | 142 | | 142 | |
| LR chi2 (1) | 28.93 | | | |
| Prob > chi2 | 0.001 | | | |

**Note:** ***, **, and * signifies variables significant at 1%, 5% and 10% level of significance respectively. **Source:** Author's computations.

COVID-19 pandemic and ranked as 2nd, 3rd, 4th and 5th respectively. Meanwhile 65 countries economic policy response was at medium level and 102 countries response was at low level. Thus, comparing to the June, 2020, in July 2020 countries were responded more. This is because of the fact that destructive effects of COVID-19 was more in the July, 2020 and to combat the negative effects, countries' economic policy response were more than that of the June, 2020. Similarly in the August 2020, we found comparing to other countries, Chile, Switzerland, Croatia, Sweden and Netherland responded more to COVID-19 pandemic and ranked as 1st, 2nd, 3rd, 4th and 5th respectively. We also found that 65 countries economic policy response was at medium level and 103 countries response was at low level. So, comparing to June and July, 2020, in August, 2020 countries' policy responses were more as their $ICES_3$ score have improved.

Similarly, in September, 2020 we found Croatia's policy response to COVID-19 pandemic was high and Sweden, Switzerland, Chile, and

Netherland responded more to COVID-19 pandemic and ranked as 2nd, 3rd, 4th and 5th respectively. We also found that 75 countries economic policy response was at medium level and 92 countries response was at low level. From the viewpoint of status of the countries responding to COVID-19, there is only two countries achieved 'High' specifically, in the month of July, Chile and in month September, 2020, Croatia responded highly to the COVID-19 by providing more economic stimulus packages resultant is that they were able to control the negative effects of COVI-19 pandemic. We also found that in 'Medium' stated response to COVID-19, Sweden, Switzerland, Netherland, and Croatia always were top of all 'Medium' stated response to COVID-19 countries and their ICES scores are gradually improving which confirms that they provide more stimulus packages to curb the effects of COVID-19. Among the 'Low' stated response to COVI-19 countries, one worth finding is that though they achieved low status but their scores are improving in some countries for example, Afghanistan, Albania, which refers that they are trying their level best to mitigate the effects of COVID-19 pandemic.

In sum, one interesting finding is that over the time, as the situation worsen, countries tried to provide more economic stimulus packages to mitigate the negative effects of COVID-19 pandemic. Another interesting finding is that, although these medium stated countries response to COVID-19 were well, still they are far from the full economic stimulus state with an ICES score of 1.00. However, looking at ICES scores over the period of four months from June to September, 2020, we can say in most cases ICES score has improved which specifies that extent of economic stimulus package in response to COVID-19 in a country has increased. It may be that the improvement was not significant to change the respective country's ranking or status of economic stimulus, but it has moved gradually to the ideal point 1.00.

### 3.3. Factors associated with economic stimulus in response to COVID-19 pandemic

Factors that affect the process of economic stimulus as a response to COVID-19 pandemic are possible to be numerous and interaction among them is complex. For simplification, we attempt to simply identify factors those are correlated with economic stimulus packages provided in response to COVID-19 pandemic. To do the same, we first, calculate the magnitude of the associations through measuring correlations among variables and then conduct the beta regression method with our computed ICES as the dependent variable and country features, public health measures and GDP per capita as independent variable. We have applied beta regression method as it estimates the parameters of a beta regression model. Also, this model accommodates dependent variables that are greater than 0 and less than 1 (Ferrari and Cribari-Neto, 2004). In this research, dependent variable is ICES which in all cases takes a value of greater than 0 and less than 1. Table 4 exhibits the correlations among variables. According to Table 4, we found that all explanatory variables are significantly correlated with dependent variable, ICES. Correlations among explanatory variables are not significant which indicates low level of multicollinearity.

In Table 5, we report the outcomes of beta regression analyses, from column 2 to column 3 and marginal effects, dy/dx in column 4 to column 5 to report change in the outcome variable, economic stimulus, for a change in the covariates. Since the variables are scaled differently, we report outcomes in the form of a one standard deviation change in the variables. Empirical results presented in Table 5 indicate that the median age of population has noteworthy positive association with economic stimulus in response to COVID-19 pandemic which in other words means that countries with older people announced greater economic stimulus packages as a response to COVID-19 pandemic. Our findings are similar to the findings of (Elgin et al., 2020; Renzaho, 2020).

Findings exhibited in Table 5 also indicate that number of hospital beds per-capita has significant negative association with ICES score which is similar to the findings of Elgin et al. (2020). This result implies that countries with lower number of hospital beds per-capita undertaken more stringent economic stimulus packages. For example, Chile with a 2.2 number of hospital beds per capita provides more stimulus and thus achieved 'High' status in September, 2020 and one of the top five 'medium' stated response countries during the period of the study whereas for the same period, Japan whose number of hospital beds per capita is 13.4 but was 'Low' stated response countries to COVID-19. We include total cases per million population as independent variable in our study. Findings presented in Table 5 indicates that there is significant positive association between total COVID-19 cases and economic stimulus provided in response to COVID-19 pandemic. In other words, countries with higher number of confirmed cases provide more economic stimulus. This result is consistent with the findings of (Elgin et al., 2020). Another variable, namely GDP per capita has been included to examine the relation between GDP per capita and economic stimulus provided in response to COVID-19. According to Table 5, we find a positive significant ratio of GDP per capita to stimulus packages similar to the results of (Sarkodie and Owusu, 2020). This is because COVID-19 is a pandemic and thus to mitigate the negative effects, countries must provide sufficient economic stimulus regardless of their GDP. We also considered health expenditure in beta regression model. Empirical findings shown Table 5 indicate that health expenditure has significant positive association with economic stimulus packages provided for COVID-19 pandemic. This finding is similar to the results of (Benmelech and Tzur-Ilan, 2020). Finally, COVID-19 Government Response Stringency Index produced by published by the University of Oxford (Hale, Webster, Petherick, Phillips and Kira, 2020). Findings indicate a positive association of stringency index with COVID-19 economic stimulus packages.

Results of marginal effects exhibited in column 4 of Table 5 indicate that median age increases economic stimulus by 0.0048 while hospital beds decreases economic stimulus by 0.0071. Similarly we find that total number of cases, GDP per-capita, health expenditure, and COVID-19 Government response stringency index increases economic stimulus by 0.0010, 0.1005, 0.1140, and 0.0008 respectively.

## 4. Conclusion

In this study we have measured extent of economic policy responses to COVID-19 and status and progress of economic stimulus in 168 countries across the world and then identified factors associated with such economic stimulus. To measure the extent of economic stimulus of a country, we developed a composite, three dimensional index of COVID-19 economic stimulus, ICES, which is similar but not same to the common and valuable development indexes such as HDI and HPI. Categorizing the countries as low, medium and high response group to COVID-19, this study found Chile, Switzerland, Croatia, Sweden and Netherland responded more during the period of study. Empirical findings also explored that most of the country's economic stimulus package was enhanced over the period of June to September, 2020, though that improvement was not significant to change their status from low to medium to high response group. After measuring the index of COVID-19 economic stimulus, we have conducted beta regression analysis to identify determinants of economic stimulus for COVID-19. Empirical findings of this study show that country features such as median age, hospital beds per-capita, and total cases of COVID-19 pandemic, GDP, health expenditure and COVID-19 government stringency index are the significant determinants of economic stimulus. On the basis of empirical findings of this study, policymakers should focus on the determinants of economic stimulus of COVID-19, design more economic stimulus packages in such a way so that they would be able to mitigate the negative effects of COVID-19 pandemic.

The main challenge we confronted in this study is data limitation. Once the data on more number of variables and on more countries would be available, future researches could be conducted by adding more indicators or dimensions to the index that will make the index more inclusive. Another limitation is the shorter study period, four months only. Only four months data may not represent the whole scenario precisely. In addition, these findings may not persist in future as the countries may announce more (or less) economic stimulus depending on the respective country's specific needs in specific times. Thus, future researches can be conducted on longer period of data to reflect the whole scenario. In a similar fashion, future researches could use more number of variables to identify the determinants of economic stimulus provided to mitigate the negative effects of a pandemic like COVID-19. Once such an index with more number of factors would be developed in future, governments can use the index to curb the effects of pandemics by providing appropriately sufficient economic stimulus packages.

## Declarations

### *Author contribution statement*

Md. N.A. Siddik: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

### *Funding statement*

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

### *Data availability statement*

Data will be made available on request.

### *Declaration of interests statement*

The authors declare no conflict of interest.

### *Additional information*

No additional information is available for this paper.

## Appendix

Table 6. Country-wise status, rank and progress of economic policy responses to COVID-19

| Country | $ICES_1$ | | | $ICES_2$ | | | $ICES_3$ | | | $ICES_4$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Value | St | Rank | Value | St | Rank | Value | St | Rank | Value | St | Rank |
| Afghanistan | 0.140 | L | 158 | 0.139 | L | 145 | 0.144 | L | 138 | 0.145 | L | 138 |
| Albania | 0.176 | L | 105 | 0.192 | L | 93 | 0.208 | L | 85 | 0.208 | L | 91 |
| Algeria | 0.337 | M | 26 | 0.319 | M | 36 | 0.319 | M | 38 | 0.319 | M | 39 |
| Angola | 0.151 | L | 137 | 0.142 | L | 137 | 0.142 | L | 139 | 0.142 | L | 142 |
| Argentina | 0.176 | L | 106 | 0.164 | L | 110 | 0.170 | L | 106 | 0.177 | L | 108 |
| Armenia | 0.228 | L | 78 | 0.214 | L | 83 | 0.142 | L | 140 | 0.151 | L | 129 |
| Australia | 0.251 | M | 69 | 0.247 | L | 67 | 0.280 | M | 58 | 0.290 | M | 62 |
| Austria | 0.271 | M | 59 | 0.244 | L | 71 | 0.244 | L | 71 | 0.259 | M | 72 |
| Azerbaijan | 0.329 | M | 33 | 0.317 | M | 39 | 0.337 | M | 30 | 0.337 | M | 31 |
| Bahamas | 0.140 | L | 159 | 0.129 | L | 159 | 0.290 | M | 57 | 0.290 | M | 61 |
| Bahrain | 0.249 | L | 71 | 0.235 | L | 78 | 0.235 | L | 76 | 0.234 | L | 84 |
| Bangladesh | 0.332 | M | 29 | 0.319 | M | 37 | 0.339 | M | 29 | 0.340 | M | 29 |
| Barbados | 0.196 | L | 92 | 0.194 | L | 91 | 0.194 | L | 93 | 0.194 | L | 97 |
| Belarus | 0.311 | M | 46 | 0.297 | M | 52 | 0.299 | M | 53 | 0.299 | M | 55 |
| Belgium | 0.277 | M | 57 | 0.255 | M | 65 | 0.202 | L | 88 | 0.220 | L | 86 |
| Belize | 0.143 | L | 151 | 0.131 | L | 154 | 0.131 | L | 155 | 0.134 | L | 156 |
| Benin | 0.155 | L | 130 | 0.147 | L | 132 | 0.147 | L | 134 | 0.148 | L | 132 |
| Bhutan | 0.154 | L | 133 | 0.142 | L | 138 | 0.142 | L | 141 | 0.142 | L | 143 |
| Bolivia | 0.146 | L | 147 | 0.133 | L | 153 | 0.142 | L | 142 | 0.142 | L | 145 |
| Bosnia and Herzegovina | 0.162 | L | 118 | 0.150 | L | 125 | 0.141 | L | 145 | 0.141 | L | 148 |
| Botswana | 0.326 | M | 34 | 0.314 | M | 44 | 0.310 | M | 48 | 0.310 | M | 50 |
| Brazil | 0.293 | M | 51 | 0.281 | M | 56 | 0.317 | M | 40 | 0.318 | M | 41 |
| Brunei | 0.144 | L | 149 | 0.129 | L | 158 | 0.129 | L | 159 | 0.129 | L | 161 |
| Bulgaria | 0.187 | L | 100 | 0.170 | L | 106 | 0.178 | L | 102 | 0.194 | L | 95 |
| Burkina Faso | 0.142 | L | 155 | 0.139 | L | 144 | 0.140 | L | 148 | 0.140 | L | 151 |
| Burundi | 0.080 | L | 165 | 0.066 | L | 166 | 0.066 | L | 166 | 0.066 | L | 166 |
| Cabo Verde | 0.194 | L | 93 | 0.193 | L | 92 | 0.193 | L | 94 | 0.193 | L | 98 |
| Cambodia | 0.156 | L | 128 | 0.149 | L | 126 | 0.169 | L | 108 | 0.169 | L | 112 |
| Cameroon | 0.146 | L | 146 | 0.137 | L | 150 | 0.137 | L | 153 | 0.146 | L | 135 |
| Canada | 0.270 | M | 61 | 0.292 | M | 54 | 0.292 | M | 56 | 0.292 | M | 60 |
| Central African Republic | 0.155 | L | 131 | 0.148 | L | 129 | 0.156 | L | 123 | 0.156 | L | 123 |
| Chad | 0.170 | L | 112 | 0.160 | L | 114 | 0.160 | L | 119 | 0.160 | L | 120 |
| Chile | 0.418 | M | 5 | 0.507 | H | 1 | 0.490 | M | 1 | 0.489 | M | 4 |
| China | 0.358 | M | 14 | 0.342 | M | 23 | 0.345 | M | 25 | 0.345 | M | 27 |
| Colombia | 0.353 | M | 16 | 0.342 | M | 24 | 0.349 | M | 24 | 0.353 | M | 24 |

(continued on next column)

(*continued*)

| Country | $ICES_1$ | | | $ICES_2$ | | | $ICES_3$ | | | $ICES_4$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Value | St | Rank | Value | St | Rank | Value | St | Rank | Value | St | Rank |
| Congo, R | 0.142 | L | 157 | 0.133 | L | 152 | 0.132 | L | 154 | 0.134 | L | 157 |
| Costa Rica | 0.332 | M | 30 | 0.328 | M | 31 | 0.328 | M | 35 | 0.328 | M | 36 |
| Cote Ivory | 0.162 | L | 119 | 0.153 | L | 122 | 0.154 | L | 127 | 0.153 | L | 127 |
| Croatia | 0.485 | M | 2 | 0.480 | M | 2 | 0.480 | M | 3 | 0.502 | H | 1 |
| Cyprus | 0.248 | L | 73 | 0.210 | L | 85 | 0.219 | L | 83 | 0.236 | L | 83 |
| Czech Republic | 0.231 | L | 77 | 0.236 | L | 77 | 0.243 | L | 72 | 0.258 | M | 73 |
| Democratic Republic of Congo | 0.168 | L | 114 | 0.160 | L | 115 | 0.144 | L | 137 | 0.143 | L | 140 |
| Denmark | 0.208 | L | 89 | 0.235 | L | 79 | 0.235 | L | 77 | 0.249 | L | 77 |
| Djibouti | 0.153 | L | 135 | 0.141 | L | 141 | 0.141 | L | 144 | 0.141 | L | 146 |
| Dominican Republic | 0.390 | M | 7 | 0.413 | M | 8 | 0.417 | M | 9 | 0.426 | M | 7 |
| Ecuador | 0.140 | L | 160 | 0.128 | L | 160 | 0.128 | L | 160 | 0.128 | L | 162 |
| Egypt | 0.329 | M | 31 | 0.316 | M | 42 | 0.316 | M | 43 | 0.315 | M | 44 |
| El Salvador | 0.154 | L | 134 | 0.142 | L | 139 | 0.142 | L | 143 | 0.142 | L | 144 |
| Equatorial Guinea | 0.150 | L | 139 | 0.145 | L | 135 | 0.145 | L | 136 | 0.145 | L | 137 |
| Eritrea | 0.063 | L | 168 | 0.048 | L | 168 | 0.048 | L | 168 | 0.048 | L | 168 |
| Estonia | 0.262 | M | 65 | 0.238 | L | 76 | 0.238 | L | 75 | 0.256 | M | 75 |
| Eswatini | 0.158 | L | 125 | 0.151 | L | 124 | 0.165 | L | 112 | 0.165 | L | 115 |
| Ethiopia | 0.090 | L | 164 | 0.072 | L | 165 | 0.072 | L | 164 | 0.072 | L | 164 |
| Fiji | 0.310 | M | 47 | 0.299 | M | 51 | 0.303 | M | 51 | 0.303 | M | 53 |
| Finland | 0.306 | M | 49 | 0.275 | M | 59 | 0.276 | M | 61 | 0.300 | M | 54 |
| France | 0.269 | M | 62 | 0.246 | L | 68 | 0.246 | L | 68 | 0.263 | M | 68 |
| Gabon | 0.161 | L | 121 | 0.148 | L | 130 | 0.147 | L | 132 | 0.147 | L | 134 |
| Gambia | 0.368 | M | 12 | 0.352 | M | 17 | 0.359 | M | 19 | 0.359 | M | 20 |
| Georgia | 0.213 | L | 84 | 0.204 | L | 87 | 0.232 | L | 80 | 0.239 | L | 80 |
| Germany | 0.308 | M | 48 | 0.304 | M | 49 | 0.302 | M | 52 | 0.316 | M | 42 |
| Ghana | 0.153 | L | 136 | 0.145 | L | 133 | 0.163 | L | 116 | 0.181 | L | 104 |
| Greece | 0.251 | M | 70 | 0.226 | L | 82 | 0.226 | L | 81 | 0.242 | L | 78 |
| Guatemala | 0.176 | L | 107 | 0.170 | L | 104 | 0.170 | L | 107 | 0.170 | L | 111 |
| Guinea | 0.160 | L | 123 | 0.149 | L | 127 | 0.149 | L | 129 | 0.151 | L | 128 |
| Guinea Bissau | 0.150 | L | 140 | 0.137 | L | 151 | 0.161 | L | 118 | 0.140 | L | 152 |
| Guyana | 0.136 | L | 161 | 0.124 | L | 162 | 0.124 | L | 162 | 0.298 | M | 56 |
| Haiti | 0.173 | L | 108 | 0.163 | L | 112 | 0.163 | L | 115 | 0.163 | L | 118 |
| Honduras | 0.208 | L | 87 | 0.187 | L | 95 | 0.196 | L | 92 | 0.196 | L | 94 |
| Hong Kong | 0.248 | L | 74 | 0.239 | L | 75 | 0.239 | L | 74 | 0.239 | L | 81 |
| Hungary | 0.188 | L | 99 | 0.185 | L | 99 | 0.185 | L | 99 | 0.379 | M | 16 |
| Iceland | 0.271 | M | 60 | 0.255 | M | 66 | 0.252 | M | 65 | 0.251 | M | 76 |
| India | 0.364 | M | 13 | 0.401 | M | 9 | 0.418 | M | 8 | 0.384 | M | 13 |
| Indonesia | 0.358 | M | 15 | 0.349 | M | 19 | 0.353 | M | 21 | 0.353 | M | 23 |
| Iran | 0.226 | L | 79 | 0.212 | L | 84 | 0.212 | L | 84 | 0.191 | L | 99 |
| Iraq | 0.067 | L | 167 | 0.130 | L | 156 | 0.130 | L | 157 | 0.130 | L | 159 |
| Ireland | 0.241 | L | 75 | 0.256 | M | 63 | 0.257 | M | 63 | 0.273 | M | 66 |
| Israel | 0.281 | M | 54 | 0.291 | M | 55 | 0.293 | M | 55 | 0.292 | M | 59 |
| Italy | 0.222 | L | 82 | 0.258 | M | 62 | 0.249 | L | 66 | 0.270 | M | 67 |
| Jamaica | 0.313 | M | 44 | 0.294 | M | 53 | 0.294 | M | 54 | 0.294 | M | 57 |
| Japan | 0.324 | M | 36 | 0.314 | M | 43 | 0.314 | M | 44 | 0.313 | M | 45 |
| Jordan | 0.165 | L | 117 | 0.157 | L | 118 | 0.157 | L | 121 | 0.179 | L | 106 |
| Kazakhstan | 0.338 | M | 24 | 0.322 | M | 35 | 0.330 | M | 34 | 0.330 | M | 35 |
| Kenya | 0.149 | L | 142 | 0.139 | L | 146 | 0.139 | L | 150 | 0.139 | L | 153 |
| Kosovo | 0.169 | L | 113 | 0.163 | L | 111 | 0.164 | L | 114 | 0.164 | L | 117 |
| Kuwait | 0.380 | M | 10 | 0.367 | M | 16 | 0.367 | M | 17 | 0.368 | M | 19 |
| Kyrgyzstan | 0.149 | L | 143 | 0.140 | L | 143 | 0.140 | L | 147 | 0.140 | L | 150 |
| Laos | 0.238 | L | 76 | 0.239 | L | 73 | 0.221 | L | 82 | 0.238 | L | 82 |
| Latvia | 0.150 | L | 138 | 0.138 | L | 148 | 0.138 | L | 151 | 0.138 | L | 154 |
| Lebanon | 0.194 | L | 94 | 0.187 | L | 98 | 0.189 | L | 96 | 0.189 | L | 101 |
| Lesotho | 0.144 | L | 150 | 0.142 | L | 140 | 0.147 | L | 133 | 0.147 | L | 133 |
| Liberia | 0.070 | L | 166 | 0.055 | L | 167 | 0.059 | L | 167 | 0.059 | L | 167 |
| Libya | 0.304 | M | 50 | 0.278 | M | 57 | 0.278 | M | 59 | 0.293 | M | 58 |
| Lithuania | 0.293 | M | 52 | 0.265 | M | 60 | 0.246 | L | 67 | 0.261 | M | 70 |

(*continued on next column*)

(*continued*)

| Country | $ICES_1$ | | | $ICES_2$ | | | $ICES_3$ | | | $ICES_4$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Value | St | Rank | Value | St | Rank | Value | St | Rank | Value | St | Rank |
| Luxembourg | 0.320 | M | 39 | 0.312 | M | 45 | 0.312 | M | 46 | 0.312 | M | 47 |
| Madagascar | 0.168 | L | 115 | 0.163 | L | 113 | 0.163 | L | 117 | 0.163 | L | 119 |
| Malawi | 0.189 | L | 97 | 0.187 | L | 96 | 0.187 | L | 97 | 0.187 | L | 103 |
| Malaysia | 0.336 | M | 27 | 0.340 | M | 26 | 0.375 | M | 15 | 0.375 | M | 17 |
| Maldives | 0.145 | L | 148 | 0.137 | L | 149 | 0.138 | L | 152 | 0.138 | L | 155 |
| Mali | 0.279 | M | 56 | 0.244 | L | 70 | 0.244 | L | 70 | 0.259 | M | 71 |
| Malta | 0.125 | L | 162 | 0.114 | L | 163 | 0.114 | L | 163 | 0.114 | L | 163 |
| Mauritania | 0.399 | M | 6 | 0.371 | M | 14 | 0.382 | M | 14 | 0.381 | M | 14 |
| Mauritius | 0.338 | M | 25 | 0.326 | M | 32 | 0.360 | M | 18 | 0.380 | M | 15 |
| Mexico | 0.171 | L | 109 | 0.166 | L | 108 | 0.166 | L | 110 | 0.166 | L | 113 |
| Moldova | 0.329 | M | 32 | 0.317 | M | 38 | 0.318 | M | 39 | 0.318 | M | 40 |
| Mongolia | 0.160 | L | 122 | 0.157 | L | 119 | 0.185 | L | 98 | 0.194 | L | 96 |
| Montenegro | 0.350 | M | 19 | 0.349 | M | 18 | 0.349 | M | 23 | 0.356 | M | 22 |
| Morocco | 0.147 | L | 145 | 0.302 | M | 50 | 0.321 | M | 37 | 0.344 | M | 28 |
| Mozambique | 0.159 | L | 124 | 0.153 | L | 123 | 0.157 | L | 122 | 0.157 | L | 122 |
| Myanmar | 0.319 | M | 41 | 0.308 | M | 47 | 0.308 | M | 49 | 0.308 | M | 51 |
| Namibia | 0.347 | M | 21 | 0.335 | M | 28 | 0.357 | M | 20 | 0.357 | M | 21 |
| Nepal | 0.259 | M | 66 | 0.234 | L | 80 | 0.234 | L | 78 | 0.258 | M | 74 |
| Netherlands | 0.280 | M | 55 | 0.448 | M | 5 | 0.448 | M | 5 | 0.451 | M | 5 |
| New Zealand | 0.142 | L | 154 | 0.154 | L | 121 | 0.154 | L | 126 | 0.154 | L | 126 |
| Nicaragua | 0.170 | L | 110 | 0.159 | L | 117 | 0.155 | L | 125 | 0.155 | L | 125 |
| Niger | 0.317 | M | 43 | 0.304 | M | 48 | 0.304 | M | 50 | 0.305 | M | 52 |
| Nigeria | 0.226 | L | 80 | 0.316 | M | 41 | 0.316 | M | 42 | 0.315 | M | 43 |
| North Macedonia | 0.204 | L | 90 | 0.198 | L | 89 | 0.198 | L | 91 | 0.200 | L | 93 |
| Norway | 0.167 | L | 116 | 0.147 | L | 131 | 0.147 | L | 131 | 0.145 | L | 139 |
| Oman | 0.371 | M | 11 | 0.370 | M | 15 | 0.370 | M | 16 | 0.370 | M | 18 |
| Pakistan | 0.185 | L | 102 | 0.170 | L | 105 | 0.173 | L | 104 | 0.174 | L | 109 |
| Panama | 0.386 | M | 9 | 0.377 | M | 12 | 0.390 | M | 13 | 0.390 | M | 12 |
| Papua New Guinea | 0.143 | L | 152 | 0.129 | L | 157 | 0.129 | L | 158 | 0.129 | L | 160 |
| Paraguay | 0.249 | L | 72 | 0.232 | L | 81 | 0.232 | L | 79 | 0.232 | L | 85 |
| Peru | 0.347 | M | 20 | 0.344 | M | 22 | 0.344 | M | 27 | 0.340 | M | 30 |
| Philippines | 0.263 | M | 64 | 0.262 | M | 61 | 0.262 | M | 62 | 0.278 | M | 63 |
| Poland | 0.220 | L | 83 | 0.242 | L | 72 | 0.202 | L | 89 | 0.220 | L | 88 |
| Portugal | 0.252 | M | 68 | 0.239 | L | 74 | 0.239 | L | 73 | 0.239 | L | 79 |
| Qatar | 0.190 | L | 96 | 0.178 | L | 101 | 0.178 | L | 101 | 0.211 | L | 90 |
| Romania | 0.336 | M | 28 | 0.331 | M | 30 | 0.332 | M | 33 | 0.332 | M | 34 |
| Russia | 0.170 | L | 111 | 0.159 | L | 116 | 0.159 | L | 120 | 0.159 | L | 121 |
| Rwanda | 0.142 | L | 156 | 0.127 | L | 161 | 0.127 | L | 161 | 0.141 | L | 147 |
| San Marino | 0.190 | L | 95 | 0.176 | L | 102 | 0.177 | L | 103 | 0.177 | L | 107 |
| Saudi Arabia | 0.388 | M | 8 | 0.374 | M | 13 | 0.391 | M | 12 | 0.390 | M | 11 |
| Senegal | 0.189 | L | 98 | 0.185 | L | 100 | 0.185 | L | 100 | 0.189 | L | 102 |
| Serbia | 0.162 | L | 120 | 0.173 | L | 103 | 0.173 | L | 105 | 0.173 | L | 110 |
| Seychelles | 0.265 | M | 63 | 0.435 | M | 6 | 0.435 | M | 6 | 0.436 | M | 6 |
| Sierra Leone | 0.210 | L | 86 | 0.195 | L | 90 | 0.199 | L | 90 | 0.219 | L | 89 |
| Singapore | 0.283 | M | 53 | 0.255 | M | 64 | 0.255 | M | 64 | 0.275 | M | 65 |
| Slovak Republic | 0.213 | L | 85 | 0.386 | M | 11 | 0.403 | M | 10 | 0.403 | M | 10 |
| Slovenia | 0.419 | M | 4 | 0.390 | M | 10 | 0.402 | M | 11 | 0.408 | M | 9 |
| South Africa | 0.148 | L | 144 | 0.141 | L | 142 | 0.141 | L | 146 | 0.141 | L | 149 |
| South Korea | 0.155 | L | 132 | 0.142 | L | 136 | 0.151 | L | 128 | 0.151 | L | 130 |
| Spain | 0.225 | L | 81 | 0.200 | L | 88 | 0.205 | L | 87 | 0.220 | L | 87 |
| Sri Lanka | 0.317 | M | 42 | 0.316 | M | 40 | 0.316 | M | 41 | 0.319 | M | 38 |
| Sudan | 0.186 | L | 101 | 0.187 | L | 97 | 0.164 | L | 113 | 0.164 | L | 116 |
| Suriname | 0.143 | L | 153 | 0.131 | L | 155 | 0.131 | L | 156 | 0.131 | L | 158 |
| Sweden | 0.325 | M | 35 | 0.465 | M | 4 | 0.471 | M | 4 | 0.493 | M | 2 |
| Switzerland | 0.495 | M | 1 | 0.476 | M | 3 | 0.489 | M | 2 | 0.489 | M | 3 |
| Taijikistan | 0.320 | M | 38 | 0.335 | M | 29 | 0.335 | M | 32 | 0.312 | M | 48 |
| Tanzania | 0.156 | L | 129 | 0.148 | L | 128 | 0.148 | L | 130 | 0.148 | L | 131 |
| Thailand | 0.439 | M | 3 | 0.426 | M | 7 | 0.426 | M | 7 | 0.426 | M | 8 |

(*continued on next column*)

(*continued*)

| Country | $ICES_1$ | | | $ICES_2$ | | | $ICES_3$ | | | $ICES_4$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Value | St | Rank | Value | St | Rank | Value | St | Rank | Value | St | Rank |
| Togo | 0.179 | L | 104 | 0.168 | L | 107 | 0.168 | L | 109 | 0.180 | L | 105 |
| Tonga | 0.182 | L | 103 | 0.165 | L | 109 | 0.165 | L | 111 | 0.165 | L | 114 |
| Trinidad and Tobago | 0.345 | M | 22 | 0.335 | M | 27 | 0.350 | M | 22 | 0.350 | M | 25 |
| Tunisia | 0.157 | L | 127 | 0.145 | L | 134 | 0.145 | L | 135 | 0.145 | L | 136 |
| Turkey | 0.351 | M | 17 | 0.340 | M | 25 | 0.340 | M | 28 | 0.350 | M | 26 |
| Turkmenistan | 0.208 | L | 88 | 0.190 | L | 94 | 0.190 | L | 95 | 0.190 | L | 100 |
| Uganda | 0.311 | M | 45 | 0.324 | M | 34 | 0.324 | M | 36 | 0.324 | M | 37 |
| Ukraine | 0.319 | M | 40 | 0.326 | M | 33 | 0.335 | M | 31 | 0.336 | M | 33 |
| United Arab Emirates | 0.199 | L | 91 | 0.206 | L | 86 | 0.206 | L | 86 | 0.205 | L | 92 |
| United Kingdom | 0.258 | M | 67 | 0.245 | L | 69 | 0.245 | L | 69 | 0.261 | M | 69 |
| United States | 0.274 | M | 58 | 0.277 | M | 58 | 0.277 | M | 60 | 0.278 | M | 64 |
| Uruguay | 0.321 | M | 37 | 0.312 | M | 46 | 0.312 | M | 47 | 0.312 | M | 49 |
| Uzbekistan | 0.150 | L | 141 | 0.138 | L | 147 | 0.139 | L | 149 | 0.143 | L | 141 |
| Vietnam | 0.351 | M | 18 | 0.345 | M | 21 | 0.345 | M | 26 | 0.336 | M | 32 |
| Yemen | 0.098 | L | 163 | 0.077 | L | 164 | 0.066 | L | 165 | 0.066 | L | 165 |
| Zambia | 0.157 | L | 126 | 0.156 | L | 120 | 0.156 | L | 124 | 0.155 | L | 124 |
| Zimbabwe | 0.342 | M | 23 | 0.348 | M | 20 | 0.312 | M | 45 | 0.312 | M | 46 |

**Note:** 'St' refers to 'Status', 'L' refers to 'Low', and 'M' refers to 'Medium'.
**Source:** Author's computations

## References


Albuquerque, R., Koskinen, Y., Yang, S., Zhang, C., 2020. Resiliency of environmental and social stocks: an analysis of the exogenous COVID-19 market crash. The Review of Corporate Finance Studies, pp. 1–17.

Anderson, R.M., Heesterbeek, H., Klinkenberg, D., Hollingsworth, T.D., 2020. How will country-based mitigation measures influence the course of the COVID-19 epidemic? Lancet 395 (10228), 931–934.

Baker, S.R., Bloom, N., Davis, S.J., Kost, K., Sammon, M., Viratyosin, T., 2020. The unprecedented stock market reaction to COVID-19. The Review of Asset Pricing Studies, pp. 1–17.

Bayer, C., Born, B., Luetticke, R., Müller, G., 2020. The Coronavirus Stimulus Package: How Large Is the Transfer Multiplier? CEPR Working Paper No. 14600.

Benmelech, E., Tzur-Ilan, N., 2020. The Determinants of Fiscal and Monetary Policies during the COVID-19 Crisis, pp. 1–43. NBER working paper no. 27461.

Capano, G., Howlett, M., Jarvis, D.S., Ramesh, M., Goyal, N., 2020. Mobilizing policy (in) capacity to fight COVID-19: understanding variations in state responses. Policy and Society 39 (3), 285–308.

Cheng, C., Barceló, J., Hartnett, A.S., Kubinec, R., Messerschmidt, L., 2020. Covid-19 government response event dataset (coronanet v. 1.0). Nat. Hum. Behav. 4 (7), 756–768.

Correia, S., Luck, S., Verner, E., 2020. Pandemics Depress the Economy, Public Health Interventions Do Not: Evidence from the 1918 Flu. Public Health Interventions Do Not: Evidence from the 1918 Flu.

Eichenbaum, M.S., Rebelo, S., Trabandt, M., 2020. The Macroeconomics of Epidemics. NBER Working Paper No. 26882. Retrieved from. https://www.nber.org/papers/w26882.pdf.

Elgin, C., Basbug, G., Yalaman, A., 2020. Economic policy responses to a pandemic: developing the COVID-19 economic stimulus index. Covid Economics 3, 1–14.

Ferrari, S., Cribari-Neto, F., 2004. Beta regression for modelling rates and proportions. J. Appl. Stat. 31 (7), 799–815.

Gourinchas, P.O., 2020. Flattening the pandemic and recession curves. In: Baldwin, R., di Mauro, B.W. (Eds.), Mitigating the COVID Economic Crisis: Act Fast and Do Whatever it Takes. VoxEu. Org. CEPR Press, pp. 31–39.

Hale, T., Petherick, A., Phillips, T., Webster, S., 2020a. Variation in Government Responses to COVID-19. Blavatnik School of Government Working. Paper No. 2020/031.

Hale, T., Webster, S., Petherick, A., Phillips, T., Kira, B., 2020b. Oxford COVID-19 Government Response Tracker. Blavatnik School of Government. Retrieved from. https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker#data.

International Monetary Fund, 2020. Policy Responses to COVID-19. Retrieved from. https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#U.

Prem, K., Liu, Y., Russell, T.W., Kucharski, A.J., Eggo, R.M., Davies, N., 2020. The effect of control strategies to reduce social mixing on outcomes of the COVID-19 epidemic in Wuhan, China: a modelling study. Lancet Publ. Health 5 (5), e261–e270.

Renzaho, A., 2020. The need for the right socio-economic and cultural fit in the COVID-19 response in Sub-Saharan Africa: examining demographic, economic political, health, and socio-cultural differentials in COVID-19 morbidity and mortality. Int. J. Environ. Res. Publ. Health 17 (10), 1–4.

Sarkodie, S.A., Owusu, P.A., 2020. Global assessment of environment, health and economic impact of the novel coronavirus (COVID-19). Environ. Dev. Sustain. 1–11.

Sarma, M., 2015. Measuring financial inclusion. Econ. Bull. 35 (1), 604–611.

Vyas, S., Kumaranayake, L., 2006. Constructing socio-economic status indices: how to use principal components analysis. Health Pol. Plann. 21 (6), 459–468.

Zaremba, A., Kizys, R., Aharon, D.Y., Demir, E., 2020. Infected markets: novel coronavirus, government interventions, and stock return volatility around the globe. Finance Res. Lett. 35, 1–7.

Zelany, M.A., 1974. A concept of compromise solutions and method of displaced ideal. Comput. Oper. Res. 1 (3), 479–496.

Zhang, D., Hu, M., Ji, Q., 2020. Financial markets under the global pandemic of COVID-19. Finance Res. Lett. 101528, 1–6.