Social Medicine and Health Management (2021) Vol. 2: 1-16
Clausius Scientific Press, Canada

DOI: 10.23977/socmhm.2021.020101
ISSN 2616-2210

Examining the effects of COVID-19 Data with Panel Data Analysis

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Keywords: COVID-19, pandemic, Mathematical Model, RStudio, Panel data analysis

Abstract: In this study, the relationship between the COVID-19 outbreak spreading function, where cases, tests, age, hospitalization rate and mortality were defined as inputs, was examined for G20 countries. It also shows the extent to which countries have taken precautions against COVID-19 with the recommended congestion index. The data of G20 countries between 12.03.2020 and 29.05.2020 were analyzed and descriptive statistics were calculated from https://github.com/owid/covid-19-data/blob/master/public/data/owid-covid-data.xlsx. Panel data analysis is used to investigate the effect on the output value based on the variables in question for an event occurring at once. When examining the effect of the tightness index on the number of deaths, the correlation value was calculated as 0.7639. It has been observed that a one unit change in the hardness index increases production by 7.8017. In our study, unlike these studies, the social factors on the number of cases was examined and Panel Data Analysis Fixed Effects Model was applied using R Studio. At the same time, the relationship between the measures taken by countries and the number of cases / death rates was also examined.

1. Introduction

The COVID-19 virus, which emerged in the last months of 2019 and affected the whole world, has been named the Worldwide Infectious Disease Outbreak.

In this article, the effect of environmental factors such as number of cases, number of tests, population rate, average age, number of beds in the hospital, GDP, on the number of cases / deaths caused by the COVID-19 virus has been analyzed. First, the data of G20 countries were analyzed, and descriptive statistics (Table 2) were calculated. In the second phase of the study, Turkey, Germany and the United Kingdom two different countries implementing the strategy defined by the variable data prepared for the die case that has been investigated to what extent the effect of the patients had.

In this study, the effects of 10 input variables on the number of deaths of individuals due to the virus were analyzed with Panel Data Analysis in R Studio. As a result of the analysis, since the value of p (probably = probability) was less than 0.05, the H0 hypothesis (null hypothesis) was rejected and the H1 hypothesis was accepted which is concluded the significant relationship between variables and output. For example, when examining the effect of the stringency index on the number of deaths, the correlation value was calculated as 0.7639. It has been observed that one unit change in stringency indexincreases output by 7.8017.

The COVID-19 virus, which emerged in the last months of 2019 and affected the whole world, quickly turned into a global epidemic. The G20 countries selected as the source of this study that make up 85 percent of the world economy, 80 percent of the investment flow and two-thirds of the population. This group, United States, Germany, Argentina, Australia, Brazil, China, Indonesia, France, South Africa, South Korea, India, Italy, Japan, Canada, Mexico, Saudi Arabia, consists of Russia and Turkey. The G20 summits, which were first held in Washington in 2008 and lasted for 10 years, have been a natural platform where economic policies are discussed at the global level (Chakraborty and Maity, www.bbc.com).

Some countries, for example, spent his solitary life-quarantine policy, for example, could give Turkey and Germany. The data of three countries were analyzed between 12.03.2020 - 29.05.2020. When the literature is reviewed, it turns out that the number of studies on COVID-19 has increased significantly, especially in the first year of 2020. Most of these studies generally consist of studies examining the coronavirus from a medical / biological perspective. In this article, the number of deaths from the epidemic that occurred within the framework of the measures taken by the coronavirus was examined. In this respect, the study has a feature that can be distinguished from other articles.

We divided the studies on COVID 19 in the literature into different groups; literature review, mathematical model and statistical studies. Gulati et al. reviewed the literature and Zhao et al. studied the case studies on this subject (Gulati et al., Zhao et al.). In addition, Mi et al. COVID-19 studied the obesity rate (Mi et al.). Among the mathematical modeling studies on this subject, Torrelba-Rodriguez (2020) and Marimuthu et al., Adoke et al., Briz-Redon et al., Marimuthu et al. Shie et al. and Bonanad et al. conducted a meta-analysis and examined the temperature on this disease and age factor. Moreover, some disease-related prediction techniques, statistical classification and machine learning techniques were used. For example, Pathak et al. emphasized the classification techniques to be used in diagnosis (Pathak et al.). Ceylan studied the disease and made some predictions [14].

The spread conditions of COVID-19 have been examined by some statistical studies and predicted for some future situations. For example, statistically examining the spread of COVID-19 in Iran [15], Nepal [16], Africa [9], Saudi Arabia [23], India [7] studied by the researchers around the world. In the studies so far, only a country-based mathematical model of disease spread has been studied and analyzed. Our study analyzed and compared countries.

Table1 Literature Table

Authors, Year	**Subject**	**Modeling Approach**	**Solution Approach**
(Marimuthu et al. 2020)	COVID-19 Number of Cases Estimation	Mathematical Model	Susceptible-Exposed-Infectious-Recovered (SEIR) Method
(Chakraborty and Maity 2020)	Effects of COVID-19 Outbreak on Society	Resarch	

(Mi et al. 2020)	Estimating İnstant Case Fatality Rate of COVID-19	-	-
(Ceylan 2020)	Prediction of COVID-19 Prevalence	Auto-Regressive IntegratedMoving Average -ARIMA	
(Pathak et al. 2020)	Classification of Patients Diagnosed with COVID-19	Deep Transfer Learning Based Classification Model	
(Shi et al. 2020)	The effect of temperature on the dynamics of the COVID-19 outbreak	LOESS and DLNM Models	META Analysis
(Alshammari, Altebainawi, and Alenzi 2020)	Measures Taken to Prevent the Spread of COVID-19	-	-
(Lau et al. 2020)	Lost Cases of COVID-19	Analysis	Chi-square and Post-hoc Tests
(Torrealba-Rodriguez 2020)	COVID-19 Number of Cases Estimation	Mathematical and Computational Models	Logistic and Inverse Artificial Neural Network Model
(Middelburg, R.A.; Rosendaal 2020)	COVID-19: Cross-Country Comparisons	Sensitivity Analyses	-
(Zhao et al. 2020)	Monitoring the Origin of COVID-19 Cases		Voronoi Treemap
(Aluga 2020)	Preparation, Response and Contagibility for COVID-19	-	-
(Gulati et al. 2020)	COVID-19 Global Pandemic Research		Literature Review

While the studies on Panel data analysis that we used in our study generally deal with the time factor (Aydin-a, Aydin-b, Williams, Zhao). At the same time, although there are not many studies on panel data analysis in the literature, time factor has been applied together in some areas such as biomass energy consumption, the impact of international tourism on economic development (Güney and Kantar, Wu and Wu). Since the input-output relationship of the data included in the study was analyzed in a certain time interval, panel data analysis method with R Studio. Since the data in the study was wanted to be analyzed at a certain time interval, the Panel Data Analysis Method was chosen.

2. Method

In this section, panel data analysis process steps introduced. Panel data, balanced panel (if each unit is observed at all times), unbalanced panel (for some units if there are losses for some periods) are two types. Mixed data belonging to units such as countries, individuals, firms, or horizontal cross-section observations were combined over a certain period of time, and mixed data that is tracked over the same cross-sectional unit over time called panel data.

Panel data regression general model:

$$Y_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + \beta_k X_{kit} + u_{it} \tag{1}$$

Here;

Y = dependent variable

X = independent variable

i = number of countries; i = 1,2,3, ... N)

t = time dimension (days),

(t = number of time periods; t = 1,2,3 ... T)

β_0 = constant term

$\beta_{1 \ldots k}$,= regression coefficients

k = number of explanatory variables

u_{it} = is the error term.

Section size and time dimension are indicated by two separate subscript (i, t). Expressing the error term in the equation, ε_{it} consists of individual special effect μ_i, and random error term u_{it}.

Panel data models can be classified as follows depending on whether the parameters take value according to unit and / or time;

- Models with both constant and slope coefficients constant;

$$Y_{it} = \beta_0 + \sum_{k=1}^{K} \beta_k X_{kit} + u_{it} \tag{2}$$

- Models with constant coefficient according to the units;

$$Y_{it} = \beta_{0i} + \sum_{k=1}^{K} \beta_k X_{kit} + u_{it} \tag{3}$$

- Models with constant coefficient according to units and time;

$$Y_{it} = \beta_{0it} + \sum_{k=1}^{K} \beta_k X_{kit} + u_{it} \tag{4}$$

- The models in which all coefficients are variable according to time and units are;

$$Y_{it} = \beta_{0it} + \sum_{k=1}^{K} \beta_{kit} X_{kit} + u_{it} \quad (5)$$

Panel data analysis mostly deals with fixed coefficient variable models.

Fixed Effect Models: It essentially control or partially subtract the variables that do not change over time, their effects and responses to other variables.

The fixed effects modelin Eq.(6) is used very frequently and has the desired features in terms of statistical properties. In the general panel data;

$$Y_{it} = \beta_{01t} + \beta_{1it} X_{1it} + \beta_{2it} X_{2it} + \cdots + \beta_{kit} X_{kit} + u_{it} \quad (6)$$

fixed effect model;

$$\beta_{0it} = \beta_{0t} = \bar{\beta} + \mu_i \ ; \ \beta_{1it} = \beta_1 \, ; \beta_{2it} = \beta_2 \ldots \ \beta_{kit} = \beta_k \quad (7)$$

which it is assumed.

- μ_i= unit effects that are constant over time
- u_{it} = error term

The unit contains the effect, only the fixed parameter changes; while it is fixed, it differs according to the time and units.

Random Effect Models: It allows to predict the variable over time with unobserved variables which are assumed to be unrelated to all observed variables, or to be stronger, statistically independent. The least squares method or logistic regression method might generally be used. In our study, the least squares method was preferred.

In the general panel data;

$$Y_{it} = \beta_{01t} + \beta_{1it} X_{1it} + \beta_{2it} X_{2it} + \cdots + \beta_{kit} X_{kit} + u_{it} \quad (8)$$

the random effect model;

$$Y_{it} = \beta_{01t} + \beta_{1it} X_{1it} + \beta_{2it} X_{2it} + \cdots + \beta_{kit} X_{kit} + \mu_{i+} v_{it}$$

$$Y_{it} = \beta_{0it} + \sum_{k=1}^{K} \beta_k X_{kit} + (\mu_{i+} v_{it)} \quad (9)$$

- v_{it}= shows all errors,
- μ_i= indicates unit error, unit differences and change between units according to fixed time. (i. horizontal section represents the constant of the unit) (Williams).

2.1 Cross-sectional dependence test

The cross-sectional dependency test can be expressed by the following formula:

$$D_{BP} = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{p}_{ij}^2 \quad (5)$$

where $\hat{p}_{ij}$ represents a correlation between errors. If the null (H_0) and alternative hypotheses (H_1) used for the cross-sectional dependency test are:

H_0 : Cov (u_{it} , u_{ij}) = 0; no cross sectional dependence

H_1 : Cov (u_{it} , u_{ij}) ≠ 0; cross sectional dependence

The p-values help us determine whether the null hypothesis is accepted or not, if the calculated p probability value is less than the significance value, the null hypothesis is rejected.
If $\hat{\Delta}$ for normally distributed errors, the smaller sample properties can be shown below:

$$\hat{\Delta}_{adj} = \sqrt{N}\left(\frac{N^{-1}\check{S} - E(\check{Z}_{it})}{\sqrt{var(\check{Z}_{it})}}\right) \quad (6)$$

where $E(\check{Z}_{it}$ and $var(\check{Z}_{it})$ are equal to k and $\frac{2k(T-k-1)}{T} + 1$, respectively.

2.2 Panel unit root test

The stationarity levels of variables were tested with the CIPS panel unit test. Also, cross-sectional CADF regression was used in Eq(12 and 13)(Pesaran):

$$\Delta Y_{i,t} = a_i + b_i Y_{i,t-1} + c_i \bar{Y}_{t-1} + di\Delta\bar{Y}_t + \varepsilon_{i,t} \quad (7)$$

Where Y_t:

$$\bar{Y}_t = \frac{1}{N}\sum_{i=1}^{N} Y_{i,t}, \Delta\bar{Y}_t = \frac{1}{N}\sum_{i=1}^{N} \Delta Y_{i,t} \quad (8)$$

$\varepsilon_{i,t}$; is an error term. The $CADF_i$ shown in equation (15) is a cross-sectional augmented Dickey-Fuller statistic. The panel expressing the CIPS one hypothesis constitutes the unit root test.
A cross-sectional extended version of Pesaran's IPS test is shown in Equation (14) (Pesaran):

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} CADF_i \quad (9)$$

2.3 Panel cointegration test

This test realizes the cointegration relationship between variables by considering the cross-sectional dependency.
The test statistics developed by Westerlund and Edgerton, which are

$$LM_N^{+} = \frac{1}{NT^2}\sum_{i=1}^{N}\sum_{t=1}^{T} \hat{w}_i^{-2} s_{it}^2 \quad (10)$$

where s_{it}^2 shows partial sums of error terms while $\hat{w}_i^2$ shows long-term variances of error terms.
Panel causality test was used the toughness index was investigated. Pre-tests were not used before the causality analysis, the result test was directly performed. Therefore, pre-test was not used, and post-test data were obtained directly.

3. Application

The relationship between the COVID-19 epidemic spread function, where cases, tests, age, hospital bed ratio and mortality ratios are defined as inputs, was examined. There is a relationship between the disease spread frequency and population density. In this case, we used the “Case Tests; Stringency_Index; Population_d; Mean_Age; GDP as the Hosp_Bed (100k)” determinants and the “Death function” was defined as:

$\mathrm{GDP_{it}} = \mathrm{f}(\mathrm{BC_{it}}, \mathrm{K_{it}}, \mathrm{L_{it}})$ (11)

Equality.(11). It is modeled as follows:

$$GDP_{it} = BC_{it}^{\beta_{1i}} K_{it}^{\beta_{2i}} L_{it}^{\beta_{3i}} M_{it}^{\beta_{4i}} N_{it}^{\beta_{5i}} O_{it}^{\beta_{6i}} P_{it}^{\beta_{7i}} e^{\varepsilon_{it}} \quad (12)$$

Equality. (18)is converted to a linear form by taking the logarithm.

$$\ln GDP_{it} = \beta_{1i} \ln BC_{it} + \beta_{2i} \ln K_{it} + \beta_{3i} \ln L_{it} + \beta_{4i} \ln M_{it} + \beta_{5i} \ln N_{it} + \beta_{6i} \ln O_{it} + \beta_{7i} \ln P_{it} + \varepsilon_{it} \quad (13)$$

β_1 is the focused coefficient and represents the death rate, $\mathrm{\beta_{2i}}, \mathrm{\beta_{3i}}, \mathrm{\beta_{4i}}, \mathrm{\beta_{5i}}, \mathrm{\beta_{6i}}$ and $\mathrm{\beta_{7i}}$ represent the coefficients of the control variables which are, “Cases; Tests; Stringency Index Population; Mean Age; GDP and Hosp_Bed (100k)” in equation (19).

There is a relationship between the tests performed, the quarantine process, the treatment process and the mortality rate. Relationships between variables can be misleading if cross-sectional data are not treated as partition units in panel data models (in Fig.1). The study was conducted using the same G20 countries' COVID-19 dataset.
The data analysis process includes analyzing, cleaning, transforming and modeling data. In this study, Panel Data Analysis was performed for G20 countries with the data obtained between 12.03.2020 - 29.05.2020. The Firmness Index is determined as the scores between 1-100 of the measures taken by countries in policy areas, taken from publicly available data sources. GDP value is given in dollars. Population density is evaluated as the number of people per square meter.

According to the results, the largest deviation in the number of cases (10048,60) and deaths (929,60) occurred in the USA, and the number of cases in the United Kingdom gained momentum at the beginning of the specified date and increased by 8719, or 99%, in the first month [31,32,33].Descriptive statistics such as standard deviation, mean and coefficient of variation are calculated in Table 2.

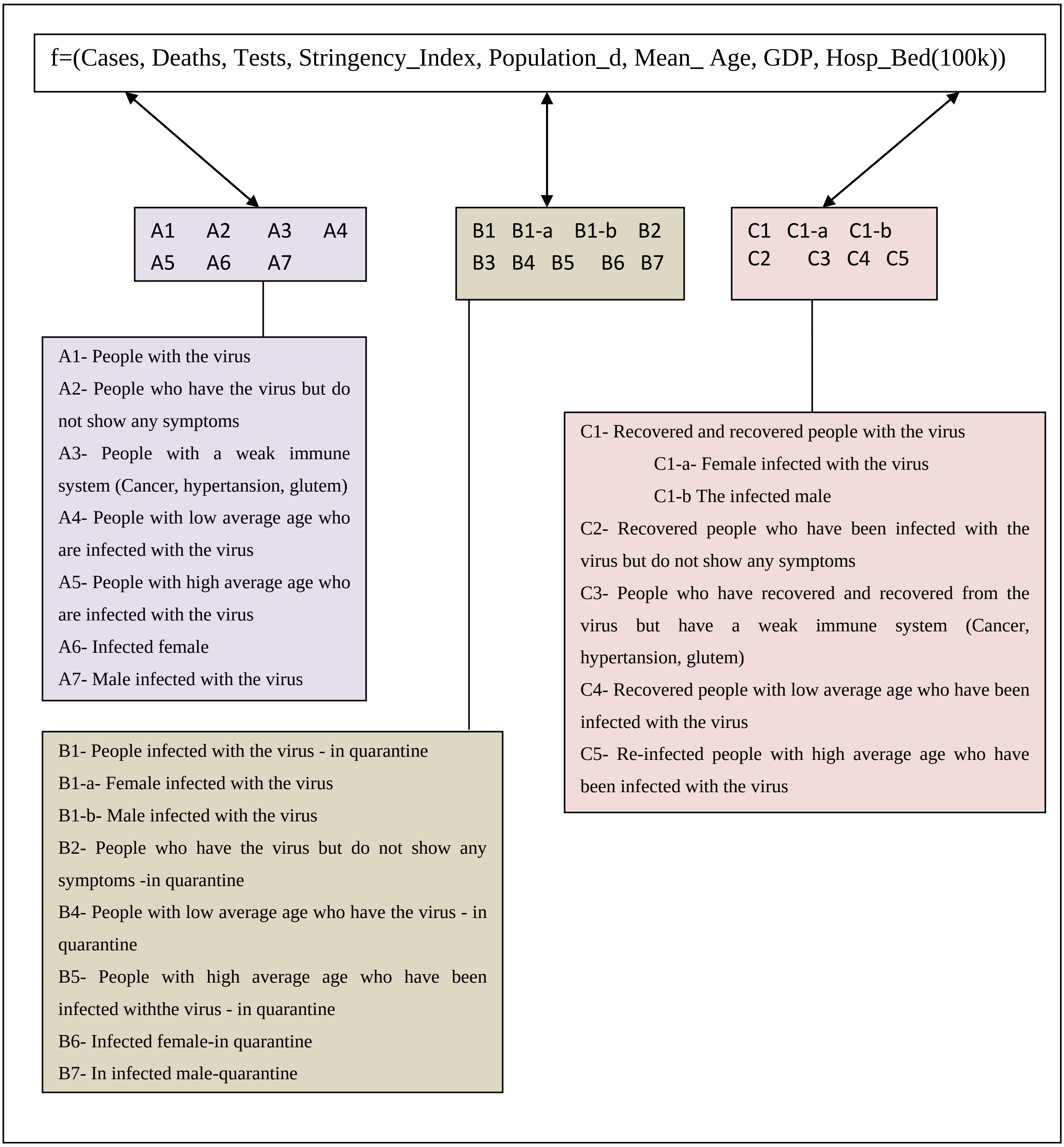

Fig.1 COVID19 Pandemic Data Model Factors

Table 2 Descriptive Statistics Results

Countries	Descriptive Statistics	Cases	Deaths	Tests	Stringency_Index	Population_d	Mean_Age	GDP	Hosp_Bed (100k)
Argentina	Mean	188,0769	6,5	2555,405	89,22649	16,177	31,9	18933,91	5
	Std. Dev.	205,6526	5,308043	738,2309	17,63037	3,58E-15	4,65E-14	2,93E-11	0
	CV	1,09345	0,816622	0,28889	0,197591	2,21E-16	1,46E-15	1,55E-15	0
Australia	Mean	89,08861	1,265823	20194,15	63,36162	3,202	37,9	44648,71	3,84
	Std. Dev.	134,485	1,533463	11144,94	14,65379	1,34E-15	5,01E-14	2,2E-11	1,34E-15
	CV	1,509564	1,211436	0,55189	0,231272	4,19E-16	1,32E-15	4,92E-16	3,49E-16
Brazil	Mean	5546,886	338,6582	0	72,69915	25,04	33,5	14103,45	2,2
	Std. Dev.	6376,287	356,8959	0	10,52081	2,5E-14	0	2,2E-11	1,79E-15
	CV	1,149525	1,053853	0	0,144717	1E-15	0	1,56E-15	8,13E-16
Canada	Mean	1119,089	87,03797	21315,91	68,41406	4,037	41,4	44017,59	2,5
	Std. Dev.	560,0192	64,65856	11765,03	12,47223	8,94E-16	5,72E-14	7,32E-12	0
	CV	0,500424	0,742878	0,551937	0,182305	2,21E-16	1,38E-15	1,66E-16	0
China	Mean	40,48101	18,6962	0	69,0426	147,674	38,7	15308,71	4,34
	Std. Dev.	51,4953	144,9166	0	11,22808	2,57E-13	4,29E-14	3,11E-11	4,47E-15
	CV	1,272085	7,751126	0	0,162625	1,74E-15	1,11E-15	2,03E-15	1,03E-15
France	Mean	1864,392	362,3924	0	84,99662	122,578	42	38605,67	5,98
	Std. Dev.	1614,831	370,6692	0	12,43773	1E-13	0	4,39E-11	6,26E-15
	CV	0,866143	1,022839	0	0,146332	8,17E-16	0	1,14E-15	1,05E-15
Germany	Mean	2267,873	106,9367	51068,54	65,01756	237,016	46,6	45229,25	8
	Std. Dev.	1858,818	86,72774	7970,613	11,52183	2,86E-13	6,44E-14	7,32E-11	0
	CV	0,8196	0,8110	0,1560	0,177211	1,21E-	1,38E-	1,62E-	0

		3	19	77		15	15	15	
India	Mean	2098,089	59,56962	54699,12	86,16405	450,419	28,2	6426,674	0,53
	Std. Dev.	2184,723	57,14056	37894,78	17,43924	8,58E-13	1,43E-14	0	5,59E-16
	CV	1,041292	0,959223	0,692786	0,202396	1,91E-15	5,07E-16	0	1,05E-15
Indonesia	Mean	314,3462	19,17949	2891,032	62,0739	145,725	29,3	11188,74	1,04
	Std. Dev.	210,5003	14,03497	2000,788	11,81742	2E-13	1,07E-14	1,83E-11	6,7E-16
	CV	0,669645	0,73177	0,692067	0,190377	1,37E-15	3,66E-16	1,64E-15	6,45E-16
Italy	Mean	2804,848	411,5316	46281,92	83,46	205,859	47,9	35220,08	3,18
	Std. Dev.	1734,242	233,1007	19161,18	12,81807	2,57E-13	6,44E-14	3,66E-11	4,92E-15
	CV	0,618302	0,566422	0,41401	0,153583	1,25E-15	1,34E-15	1,04E-15	1,55E-15
Japan	Mean	204,443	10,91139	0	43,90527	347,778	48,2	39002,22	13,05
	Std. Dev.	224,8418	13,70962	0	3,002683	5,15E-13	7,15E-14	6,59E-11	1,79E-14
	CV	1,099777	1,25645	0	0,06839	1,48E-15	1,48E-15	1,69E-15	1,37E-15
Mexico	Mean	1030,291	114,481	2745,105	67,87384	66,444	29,3	17336,47	1,38
	Std. Dev.	1027,554	135,328	2034,292	28,79821	7,15E-14	7,15E-15	2,2E-11	1,12E-15
	CV	0,997343	1,1821	0,741062	0,42429	1,08E-15	2,44E-16	1,27E-15	8,1E-16
Russia	Mean	4797,987	52,43038	129051,5	77,4216	8,823	39,6	24765,95	8,05
	Std. Dev.	4189,959	51,49052	88094,11	13,39408	1,07E-14	5,72E-14	3,3E-11	3,58E-15
	CV	0,873274	0,982074	0,682627	0,173002	1,22E-15	1,44E-15	1,33E-15	4,44E-16
Saudi Arabia	Mean	1014,747	5,582278	18256,9	86,4688	15,322	31,9	49045,41	2,7
	Std. Dev.	957,2109	6,566972	16270,72	17,58805	2,378078	4,951095	7612,178	0,419058
	CV	0,9433	1,176396	0,891209	0,203403	0,155207	0,155207	0,155207	0,155207
South Africa	Mean	346,7848	7,303797	8544,26	78,32321	46,754	27,3	12294,88	2,32
	Std. Dev.	390,6193	10,43706	6634,639	18,90081	6,44E-14	2,15E-14	1,83E-11	4,02E-15

	CV	1,126403	1,428991	0,776502	0,241318	1,38E-15	7,86E-16	1,49E-15	1,73E-15
South Korea	Mean	46,16456	2,64557	8161,658	59,32634	527,967	43,4	35938,37	12,27
	Std. Dev.	43,62322	2,552214	3698,987	16,82994	3,43E-13	5,72E-14	2,93E-11	1,25E-14
	CV	0,94495	0,964712	0,453215	0,283684	6,5E-16	1,32E-15	8,15E-16	1,02E-15
Turkey	Mean	2090,636	57,93506	26667,64	73,93328	104,914	31,6	25129,34	2,81
	Std. Dev.	1428,722	39,3066	12443,14	11,53814	7,15E-14	4,65E-14	1,1E-11	1,34E-15
	CV	0,683391	0,67846	0,466601	0,156062	6,82E-16	1,47E-15	4,37E-16	4,77E-16
United Kingdom	Mean	3401,949	478,8608	27747,11	65,73182	272,898	40,8	39753,24	2,54
	Std. Dev.	1861,314	338,6889	26277,93	19,88917	5,72E-14	5,01E-14	3,66E-11	1,34E-15
	CV	0,547132	0,70728	0,947051	0,302581	2,1E-16	1,23E-15	9,21E-16	5,28E-16
United States	Mean	21781,33	1285,937	197139,4	70,13961	35,608	38,3	54225,45	2,77
	Std. Dev.	10048,59	929,5974	120587,7	9,342489	2,15E-14	4,29E-14	7,32E-12	3,58E-15
	CV	0,46134	0,722895	0,611688	0,133198	6,02E-16	1,12E-15	1,35E-16	1,29E-15

Panel data analysis was used in this study. Finally, data behavior can be monitored with panel data analysis. By creating a statistical model based on a dynamic COVID-19 spread pandemic model and time series analysis, which is aimed to create a prediction model for later time periods. Since the outbreak of available data is relatively large sample data, in the spread of 2019-nCoV at this stage, the established model shows the development trend of the epidemic, the peak size, etc. time series analysis of statistical modeling was created with a more accurate short-term prediction of situations (in Fig.2).

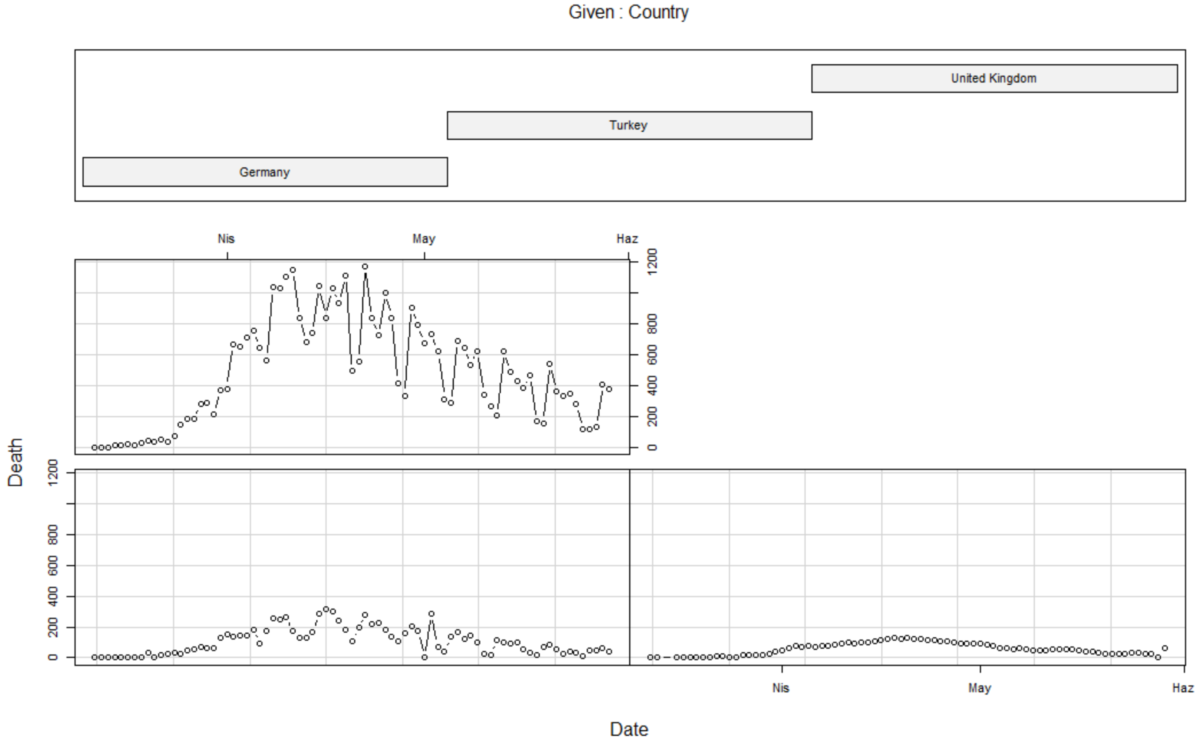

Fig.2 Number of deaths by time, by country

4. Results and Discussion

By the according to the cross-sectional dependence and slope homogeneity test results such as CDBP, CDLM and CD shown in Table 2, the cross-sectional independence null hypothesis, that no relationship between variables was rejected. The result of this hypothesis were revealed that there is a cross-sectional dependency in all variables examined. While performing Data Panel Analysis with R Studio, foreign, readxl, car, apsrtable, plm, gplots packages were used.

As Figure 2 shows, the UK's death numbers were high between April and May. Although there is a decline after May, the latest is around 400. Germany continued by jumping less value in this distribution, in Turkey about 0-200 numbers remained more stable.Regular OLS(Ordinary Least Squares) regression does not take into account heterogeneity between groups or times. Figure 3 and Figure 4 represent the heterogenity across countries and date.

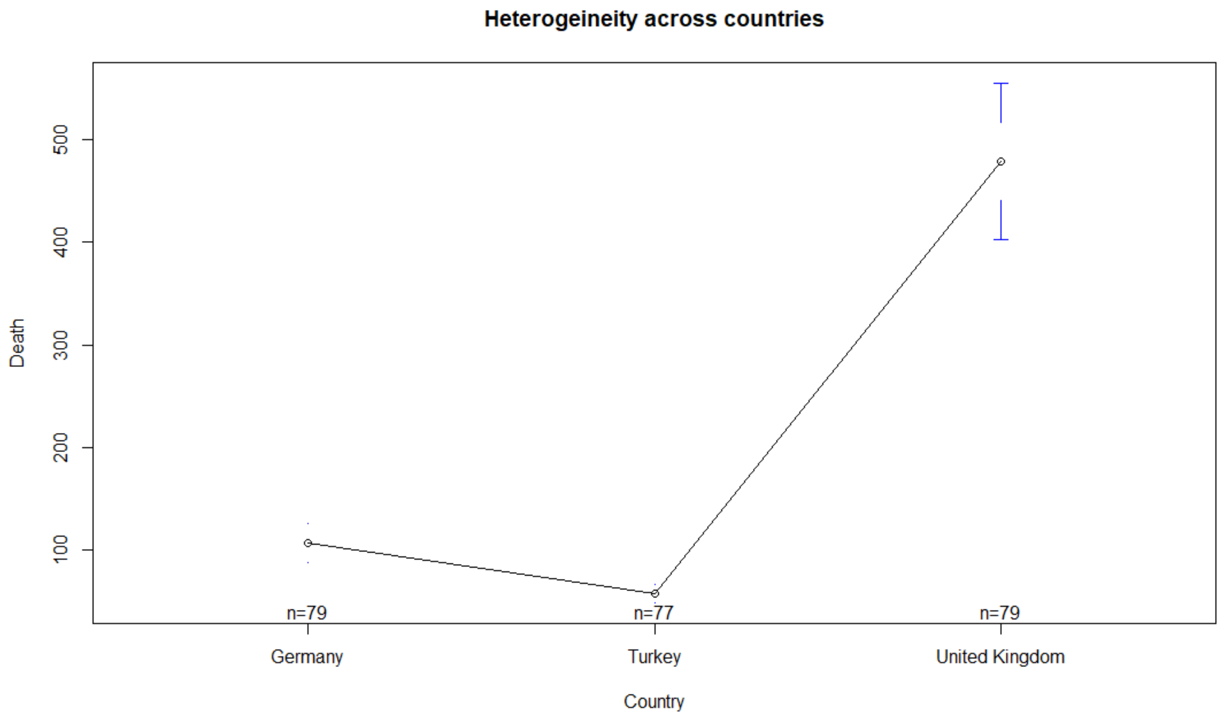

Fig.3 Fixed effects: Heterogeneity between countries (or units)

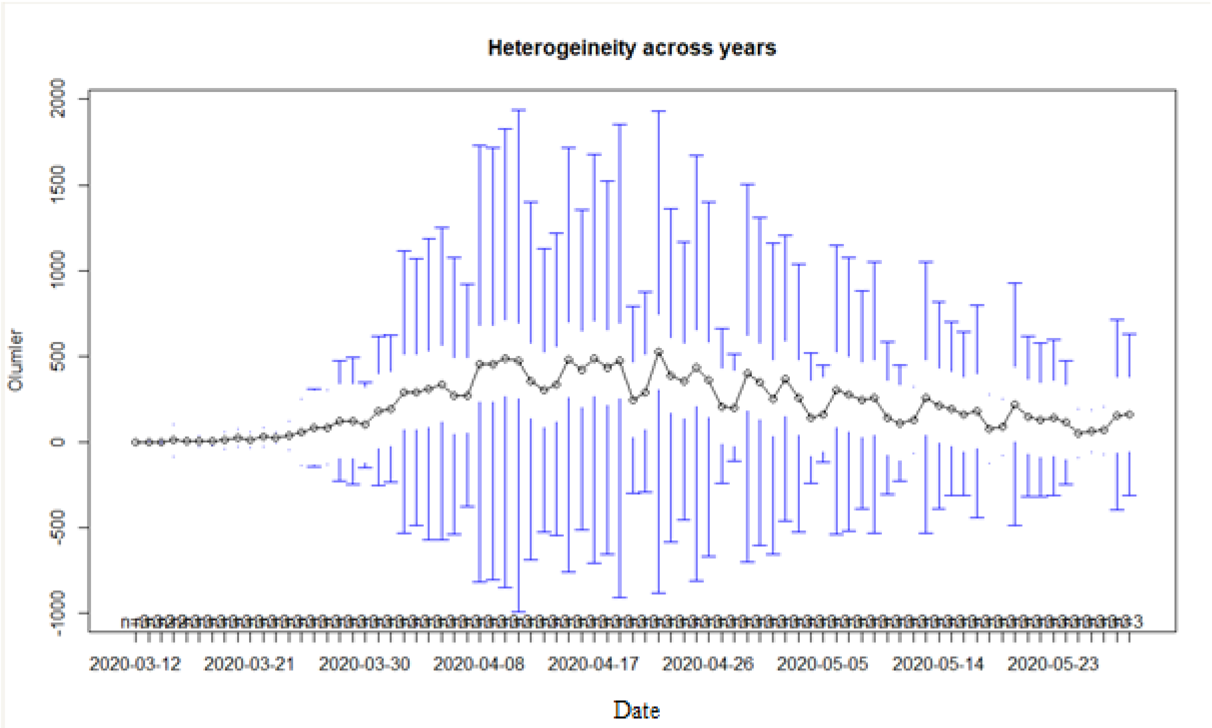

Fig.4 Fixed effects: Heterogeneity respect from date

4.1 Constant Effects Using the Least Squares Dummy Variable Model

As a result of the analysis, the model is significant because the p value = 2e-16 is less than 0.05. Since the correlation coefficient = 0.7639 is a value close to 1, there is a strong relationship between the tightness index and the measurements. A one-unit change in the tightness index increases the number of deaths by 7.8017 units. A unit change in stiffness index for Germany, 399.4421 units to Turkey, 514.5541 units, 31.7702 units show a decrease in the number of deaths for England(in Table 3).

Table 3 Relationship between tightness index and deaths

```
 Estimate Std. Error t value Pr(>|t|)

Tightness_Index                 7.8017     0.7874   9.908  < 2e-16***
factor(Countries)Germany       -399.4421    54.8738  -7.279 6.01e-12 ***
factor(Countries)Turkey        -514.5541    61.9943  -8.300 1.09e-14 ***
factor(Countries)United Kingdom  -31.7702    55.4446  -0.573    0.567
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Adjusted R-squared:  0.7639
p-value: < 2.2e-16 (0.00000000000000022)
```

4.2 Conclusion and Feature Studies

When the variables used in the study from the epidemic was investigated, a significant effect found, especially of the tightness index differences in the country's economic measures might in the effectiveness.

The variables effects used in the analysis on the number of cases and deaths. For example, there is a significant relationship between the tightness index and those who died from the epidemic. However,the tightness index values were taken necessary measures.

A retrospective research (fillation) can be conducted for the person with the virus, people in this group had the disease or the physical environment or biological characteristics of the people who are not affected.

Author Statements

Contributors

All authors provided data, developed models, studied results, provided guidance on methodology or review and approval of the final version manuscript.

Ethical Approval

We used the open share data[https://github.com/owid/covid-19-data/blob/master/public/data/owid-covid-data.xlsx].

Data sharing

The authors are open to sharing statistical codes and study data.

Declaration of interests

We declare no competing interests.

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