Bulletin of the *Transilvania* University of Braşov
Series V: Economic Sciences • Vol. 13 (62) No. 1 – 2020
https://doi.org/10.31926/but.es.2020.13.62.1.14

EU COUNTRIES FIGHTING THE COVID-19 PANDEMIC

C. DUGULEANA[1] L. DUGULEANA[2]

Abstract: *The EU countries have been affected by COVID-19 disease with different intensities. Some countries faced higher number of ill people and deaths, while others seem to record fewer cases and lower case fatality rates. These last countries better handled the physical distancing measures of their population. The entire European population is scared of the rapid evolution and spread of the pandemic. The present paper highlights the positions of EU countries in May 2020 and the main factors influencing the differences of the EU countries fighting with COVID-19 disease. The conclusion argues the huge influence of pollution for the evolution of COVID-19 and the direct connection with the economic development.*

Key words: *GDP per capita, Pollution, Principal Components Analysis, Covid-19 pandemic.*

1. Introduction

The unfolding of events related to pandemic COVID-19 is still subject of tremendous discussions at international level.

An international emergency of public health concern was firstly announced by the World Health Organization (WHO) on 30 January 2020. The disease started from Wuhan, China, at the end of December 2019. The name of the new coronavirus COVID-19 was pronounced by WHO Director-General on 11 February 2020. On March 11, 2020, the outbreak of a global pandemic with the novel coronavirus, COVID-19 was declared. (www.worlmeters.info)

The deep and quick changes caused by the COVID-19 pandemic affected the countries' economies. The state governments have reacted by restrictions of traveling, working, and living.

People's social, economic, physical, and mental life has dramatically changed; the normality of life was gone and so it continues to be. People were forced to stay at home, some of them unemployed, with limited living resources. Faced with unemployment, immigrants came back to Romania, going directly into quarantine or into hospitals in case of already being infected with COVID-19.

[1] *Transilvania* University of Braşov, cduguleana@unitbv.ro
[2] *Transilvania* University of Braşov, ldugul@unitbv.ro

The majority of working activities moved online. But important economic industries stopped and the Planet took a break of about two months. The Earth amazingly reinvigorated itself like have breathing the fresh air of spring.

The fight with the pandemic disease is strong in hospitals, scientific research institutes in biology and medicine, but also for governmental institutions and health authorities responsible for testing, controlling, and preventing the spread of the virus. The knowledge of everything about the new coronavirus and its incubation period, allows an understanding of the spreading time, in order to establish the effective treatments and the quarantine systems.

The people were notified by media upon symptoms of the disease and they were advised by the authorities to stay home in self-isolation to protect themselves. Even if some restrictions are lifted and economic activity is resumed, people must follow the rules of keeping distance from each other. New rules of life will change mindsets and gradually assimilate into a new normality of human behaviour.

This fight will continue until a research result will provide an efficient treatment against COVID-19 and will assure the health of entire population.

2. Methodology and Data

2.1. Data in the study

The study was done for the European countries fighting with the COVID-19 pandemic, with the purpose of presenting the main causes and the position of countries in the strategy approach of this fight. Identifying the causes can show the direction of measures the countries and international organizations should further envisage.

In our study, from all the considered indicators of economic, social and health nature, only the following indicators proved to be significantly influencing the current pandemic fight:

- GDP/inhabitant at current prices *(GDP_cap)*, euro per capita, in 2019 (Eurostat, Main GDP aggregates per capita, https://ec.europa.eu/eurostat/);
- the recorded number of infected people with COVID-19 *(covid_nr)* at the end of April 2020 (www.worldometers.info);
- death rate *(death_r),* meaning cause fatality rate, at the end of month April 2020, calculated as ratio between the death cases with COVID-19 and number of infected people (www.worldometers.info);
- recover rate *(recover_r)*, calculated as ratio between total recovered and total cases, and
- Greenhouse gases (CO2, N2O in CO2 equivalent, CH4 in CO2 eq., HFC in CO2 eq., PFC in CO2 eq., SF6 in CO2 eq., NF3 in CO2 eq.), million tonnes, in industrial processes and product use *(green_gas)*, recorded in 2017 (Eurostat, European Environment Agency (EEA), Greenhouse gas emissions by source sector).

We also considered demographical information concerning the structure of countries' population, like: Young-age dependency ratio (population aged 0-19 to population 20-59 years) in 2019, Old dependency ratio (population 60 and over to population 20 to 59 years) in 2019, Life expectancy at birth (years) in 2017, Population density (pers./km^2),

2018. Also, unemployment rate (%) in 2019 and Health care expenditure by all providers (% in GDP) available to 2017 - seemed to be unimportant in our analysis. These last indicators could have influenced the socio-economic status of the European countries in the COVID-19 context of 2020. We could have considered that the health care % of GDP might have been the same in 2019, as in 2017. Even considering the % of GDP for health care in 2017, for all the countries, it should have been the influence at the level of the same year with their consequences until nowadays. But it was not the case with these indicators.

Other indicators from the health sector like: the total cases /1 million persons, number of deaths /1 million persons, total tests and number of tests /1 million persons – also proved to be insignificant for modelling the causes of the European context approached by our study.

2.2. Methodology of the study

Using all the described indicators we applied the Principal Components Analysis (PCA) in SPSS to describe the status of the European countries at the end of April 2020 in the context of COVID-19 disease.

Based on a dataset for more territorial-administrative units for which more variables are recorded, a PCA may find the essential features of all data, combining the influences of variables around two or more components. The PCA method emphasizes a number of components according to the number of Eigenvalues identified as greater than 1, only if two main components are chosen. Because it is difficult to interpret more components, usually two components are set to be identified. The linear combinations of significant variables define the components, which are named by us. The two components are orthogonal on the chart “circle of correlations”; on this chart the variables closer to the axis and to value 1 define the component.

These components explain the variation between the European countries in our study, concerning the pandemic disease of COVID-19. The statistical units are representative for either the positive or the negative direction of the component, lying opposite at one of the two heads of the line representing the component, on the “chart of individuals”. The importance of the units on the components' axes is higher when the larger is its projection on the axis. At the axes’ intersection there are the units around the average values of both components.

3. Results and Discussions

3.1. Principal Components’ Analysis of the European countries in the Covid-19 context at the end of April 2020

The repeated PCAs in order to obtain more proportion of explained variation between European countries revealed only two components, meaning Eigenvalues higher than 1.

We found a good model which explains, 81.7% of the variation between the analysed countries, as seen in Table 1. The first component explains 56.5% and the second component explains 25.2% of the variation.

Total Variance Explained Table 1

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,260	56,508	56,508	2,260	56,508	56,508	2,259	56,486	56,486
2	1,009	25,220	81,728	1,009	25,220	81,728	1,010	25,242	81,728
3	,555	13,868	95,596						
4	,176	4,404	100,000						

Extraction Method: Principal Component Analysis.

The two components are defined by the variables correlated with them, in Table 2.

The first component comprises the variables: *covid_nr* with the highest simple correlation coefficient of 0.937*, green_gas* with 0.875 and *death_r* with 0.784. This could be *the component of environment* or *the COVID context*, referring to the health of population and the quality of air, of their physical surroundings.

The second component is represented only by the GDP per capita; the variable *GDP_cap* is very strong correlated with this component with a correlation coefficient of 0.996. This component is that of *economic development*.

The variables as *the total tests* and *number of tests /1 million persons* are also influenced by the country economic development. Even the *recovery rate* is an issue of economic reasons, depending on the health care system development.

Rotated Component Matrix[a] Table 2

	Component	
	1	2
death_r	**,784**	,061
covid_nr	**,937**	,024
green_gas	**,875**	-,112
GDP_cap	-,006	**,996**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

The circle of correlations in Fig. 1 emphasizes the two components described above. In figure 1, the fact that this variable *(green_gas)* is very close to the indicators of Covid-19 disease *(covid_nr)* is an evidence of the main cause of this health problem caused by the pandemic. The countries which are economically well-developed also have the Greenhouse gases in industrial processes and product use *(green_gas)* at high levels. We would expect to see the pollution level close to GDP per capita, but it is very close to the other component, the first component of *Covid-19 disease*.

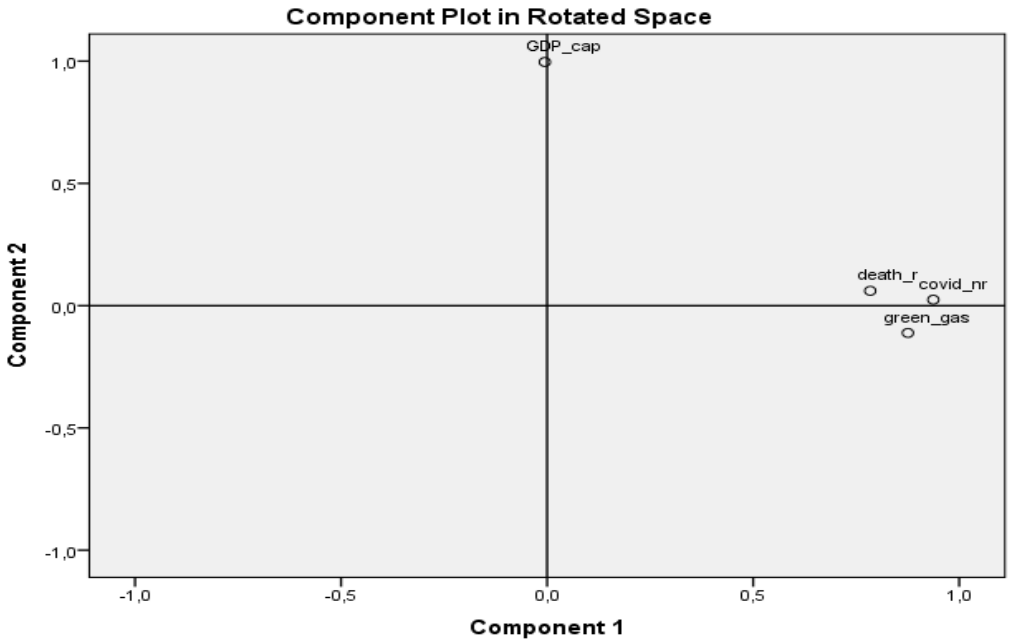

Fig. 1. *The "circle of correlations" between the components and the variables*

Interpreting the position of European countries on the chart of individuals, in figure 2, we notice the group of the five countries: France, Italy, United Kingdom, Germany, and Spain with the greatest number of Covid-19 cases, the highest death rates and the highest value of pollution. These countries are placed at around or more than two standard deviations face to the average level of the European countries on the first axis. These countries are well-developed economically, being placed close to the average level of GDP per capita of all analysed countries, on the second component.

A group of three countries lies between zero and one standard deviation plus face to the average level of the European countries on the first axis: Belgium had more deaths and ill people of Covid-19, followed by Netherlands and Sweden. Like the countries of the previous mentioned group, they are economically developed, placed over the average level of GDP per capita of all analysed countries, on the second component.

A group of more countries, which are less or more at minus one standard deviation face to the second component of the economic development, to which Romania belongs, has a lesser number of Covid-19 cases, between zero and one standard deviation less than the average level of the first component. From this group, Poland is placed on the other side, but close to the average level.

The other group of countries is more widely spread concerning the second component. Austria, Finland, Denmark, and Iceland being between zero and one standard deviation above the average level of this component; Switzerland, Ireland and Norway, between above one and two standard deviations, and Luxembourg is at three standard deviations face to the average level of economic development. All these countries had a similar position face to the first component, being all placed between zero and one standard deviation below the average level, at the end of April 2020.

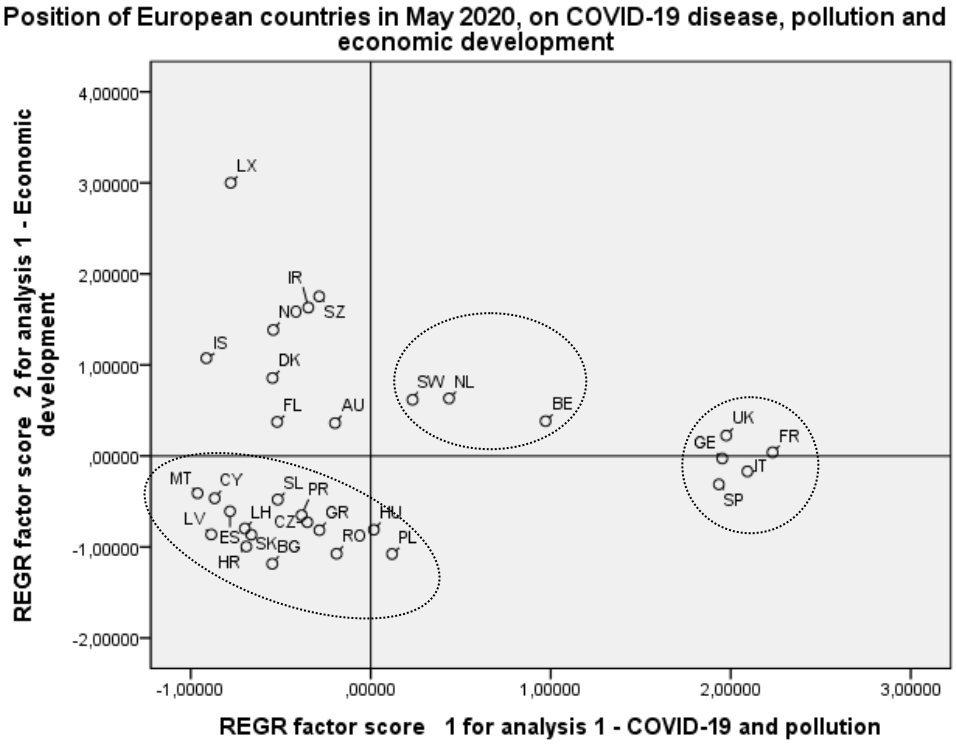

Fig. 2. *The "chart of individuals"*

Although the pollution is recorded for the year 2017, we still can assume that in 2019, the level was similar due to technological, institutional, and legal reasons. Additionally, the pollution influence on the health of population has the same features when considering the differences between countries, at least those existing in 2017.

Conclusion of this analysis is that the less economically developed countries, and as a consequence with lesser level of pollution from industry and product use, have a lower number of Covid-19 affected people than the more economically developed countries.

3.2. Developing the Analysis of European countries in the Covid-19 context of 2020

By introducing the variable of recovery rate *(recover_r)* in a new PCA, we see in Fig. 3 that it is assimilated by the second component. The new model explains lesser than the first one, having the determination coefficient R^2 of 74.4% of the entire variation.

The recovering potential is of economic nature, based on good equipment, sufficient drugs and professionals in medicine, good management of the health care system. This variable is not opposite to the variables of the first component of the Covid-19 context, but strongly attracted by the economic development level, and the second component becomes the economic wealth component.

The first component explains 45.4% of variation and the second component of economic nature is more important than in previous analysis, increasing until 29%.

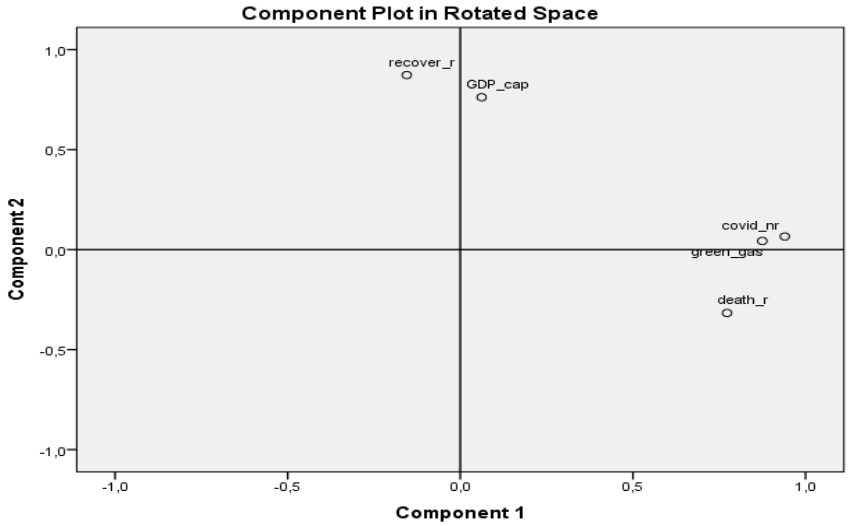

Fig. 3. *The components and the variables – 2nd PCA*

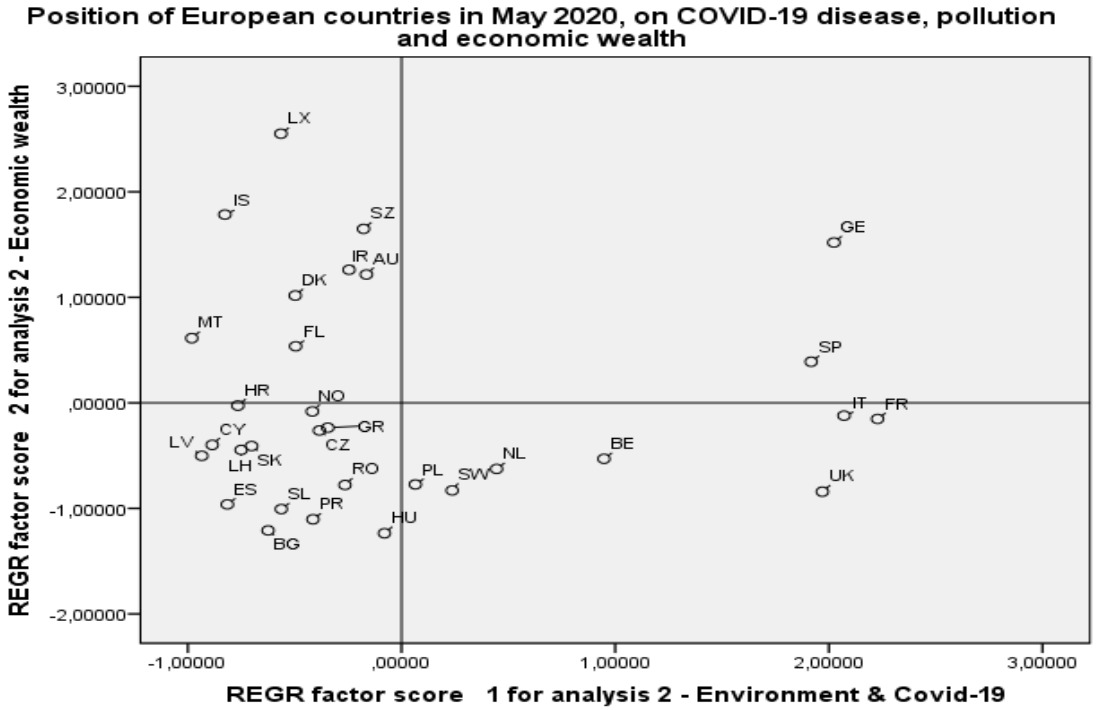

Fig. 4. *European countries on the economic and Covid-19 context of 2020 (2nd PCA)*

In figure 4 we can see the position of the European analysed countries, which is quite the same regarding the first component, but they are differently placed depending on the *GDP_cap* and *recover_r*. Germany had the highest number of recovered from the group of five countries most affected by the pandemic. By the other side UK had the

lowest number of recovered people compared to the other countries of this group.

Luxembourg, Iceland and Switzerland are well placed concerning the second component, being examples of good practices in pandemic fight. The majority of countries is placed at less and around one standard deviation to the intersection of components, on the negative side of the second component, and more spread than in previous analysis, depending on the recovery performances.

Continuing our analysis, we eliminate the death rate *(death_r)*, considering that the recovery rate *(recover_r)* and Covid-19 number of illness *(covid_nr)* emphasize the effort of the health care systems in European countries, and the number of deaths is also influenced by other factors like the comorbidities of older people infected Covid-19.

The new model explains 79.4%, close to 80%, and is almost as good as our first model.

Rotated Component Matrix[a] Table 3

	Component	
	1	2
covid_nr	**,948**	,008
green_gas	**,945**	-,051
GDP_cap	-,007	**,834**
recover_r	-,030	**,828**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

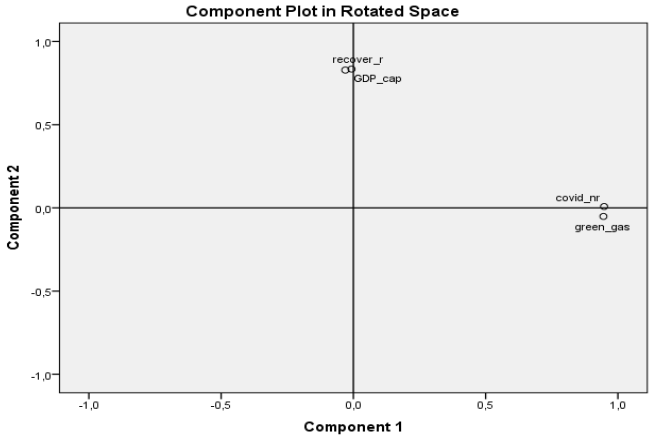

Fig. 5. *PCA (3rd analysis)*

In Table 3, the two variables of Covid-19 number of illness *(covid_nr)* and Greenhouse gases in industrial processes and product use *(green_gas)* are strongly correlated with the first component with coefficients higher than 0.94. This component of *actual health environment* affected by pollution explains 44.8% of countries' variation. The second component of *economic wealth* becomes more important, having 34.6% of variance

explanation. It is interesting how eliminating a variable in the first component emphasises the importance of the second component. When pollution has such a high impact on the number of infected people with Covid-19, the economic factors are also causes and chances to contribute to save and recover people's lives. The chart from Fig. 6 is a result of this PCA with the mentioned components. This chart doesn't consider the number of deaths of Covid-19, but only the infected people number and the recovered.

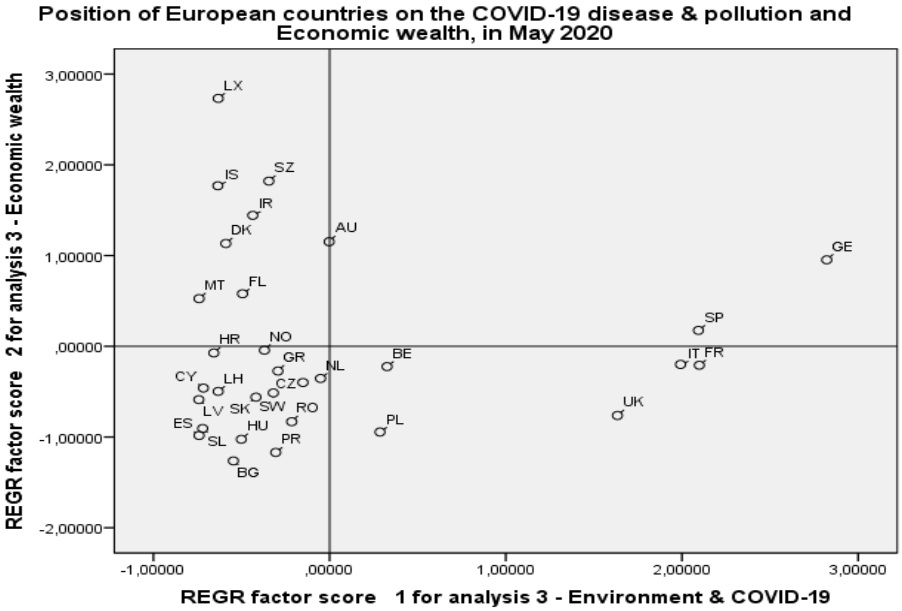

Fig. 6. *European countries position on the chart of components (3rd analysis)*

At the end of April 2020, Spain had the greatest number of 239,639 Covid cases, followed in order by Italy, UK, France, and Germany, but Germany has the pollution more than twice higher compared to Spain. We cannot say there has been a change from 2017 to 2019 in the rapport between the countries. More than that, we may interpret that pollution in 2017 influenced the current pandemic situation.

4. Conclusions

The first model is the best one, having the highest degree of explanation of variation between the analysed European countries. The other two models successively emphasised the importance of economic factors, when introducing the recovery rate *(recover_r)* in the 2nd analysis and when continuing it with eliminating the death rate of Covid-19 *(death_r)* in the 3rd analysis.

There is an explanation for the fact that eliminating the death rate of Covid-19 *(death_r)* in the 3rd analysis makes the second component more important reaching close to 35% of explanation, not the first one as expected. When adding recovery rate *(recover_r)* in the 2nd analysis, the pollution *(green_gas)* kept the same correlation

coefficient of 0.875 with the first component, exactly as in the 1st analysis. We eliminated the death rate *(death_r)* in the 3rd analysis, and the pollution *(green_gas)* increased its correlation coefficient at 0.945 with the first component, making a higher evidence of the infected cases, which had a coefficient of 0.948 with the first component. It is clear evidence for these conclusions.

The reducing measures of pollution should be the main objective of all governments, also of EU policies, and at international level. It is widely proved that pollution deeply affects people's health, but this time the pandemic will not cease until slowing pollution.

Restructuring economic activities based on high technology with low emissions and also reduced exposure of people to pollution may be the only ways to solve the pandemic problem and to overcome subsequent threats to people's health. The sustainability targets established by EU policies and international bodies implied in ensuring the life sustainability on Earth should become national objectives; each country being more determined to respect them.

This study has its own limits even because it is done at an intermediary phase of the pandemic, but it can be repeated at the end. The results will be the same as in these models, because the position of countries is relative to the intersection of the averages on the components axes; their relative position between them will not change. This study offers a descriptive situation, available for current times, but useful to identify the influence factors and offering the basis for building explanatory models of the pandemic disease.

References

Eurostat, European Environment Agency (EEA), Greenhouse gas emissions by source sector, 2017, Last update: 24.02.2020, Date of extraction: 01.05.2020, https://ec.europa.eu/eurostat/

Eurostat, Life expectancy, Last update: 24.02.2020, Date of extraction: 01.05.20, https://ec.europa.eu/eurostat/

Eurostat, Main GDP aggregates per capita, https://ec.europa.eu/eurostat/, Last update: 30.04.2020, Date of extraction: 01.05.20

Eurostat, Population density, persons per km^2, 2018, Last update: 12.03.2020, Date of extraction: 03.05.20, https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tps00003

Eurostat, Population: Structure indicators, Last update: 30.03.2020, Date of extraction: 01.05.20, https://ec.europa.eu/eurostat/

Eurostat, Real GDP per capita, Last update: 30.04.2020, Date of extraction: 01.05.20, https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode= sdg_08_10

https://data.worldbank.org/indicator/EN.ATM.CO2E.PC
http://data.worldbank.org/indicator/EN.ATM.CO2E.KT

https://worldometers.info, Last update: 30.04.2020, Date of extraction: 01.05.2020.