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THE MAIN DETERMINANTS OF THE COVID-19 SPREADING IN THE EUROPEAN UNION COUNTRIES

ANCA TAMAȘ

Abstract:

The aim of this paper is to identify the medical and health policies, the socio-economic, the cultural and the governance determinants of the COVID-19 spreading in the European Union countries. The methodological approaches are the critical analysis of the relevant literature and the application of the linear regression in the EViews 10 software. There were used the EU countries with complete data in the databases in the period from February 2020 to September 2021. The linear regression was applied in order to find out the main determinants for total and new positive cases / total and new deaths. The main determinants for total positive cases are: Human Development Index, median age and life expectancy with a negative impact and aged 65 older, extreme poverty and masculinity with a positive impact. The main determinants for new positive cases are: aged 65 older, control of corruption and masculinity with a negative impact and life expectancy, median age and positivity rate with a positive impact. A similar investigation was conducted for total deaths and new deaths in order to assess the pandemic crisis. The main determinants for total deaths are Human Development Index, median age and life expectancy with a negative impact and the main determinants for new deaths are the positivity rate with a strong positive impact and the Human Development Index with a strong negative impact.

Keywords:

COVID-19 Determinants, Total Cases, New Cases, Total Deaths, New Deaths

JEL Classification: C23, I18

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Introduction

Covid 19 is a disease which appeared at the end of the year 2019 and soon became the corona virus pandemics and a major global threat, therefore the literature is really recent and heterogenic.

According to Stojkoski et al (2020), the determinants of the Covid pandemics in the first wave were: the healthcare infrastructure, the economic performance, the societal characteristics, the demographic structure and the natural environment. George (2020) highlighted in his article the importance of the socio economic and cultural determinants for the corona virus spreading. According to Al-Yamani et al (2021) [1], the recovery after Covid-19 is positively influenced by literacy level and the age of the population and negatively correlated with some metabolic and respiratory diseases.

According to Harapan et al (2020), because of the quick transmission, all countries should improve their disease surveillance systems and the capacity of the national laboratory system. The importance of the quality medical services in managing the pandemics was studied by Emami Zeydi et al (2021) [2], who found out that providing quality nursing care, supported by experience and research is important in order to reduce the time of the hospitalization and to decrease the mortality caused by COVID-19.

The effects of the pandemic on education were studied by Pokhrel and Chhetri in 2021. They consider that the COVID-19 pandemic has provoked one of the worst situations for the education in the human history, affecting nearly 1.6 billion students in more than 200 countries. Cachón-Zagalaz et al (2021) consider, along the same lines, that it is necessary to insist on the search for and analysis of the behavior of parents and children in the online teaching context, in order to prevent possible academic and psychological problems. If the online teaching and learning will continue for a long time, it is very important to know how they will affect families and educational environments. According to a document of European Agency for Special Needs and Inclusive Education (2021), in this difficult pandemic context, there is more need for specific support for the vulnerable learners during the

[1] Al-Yamani, M. J., Rabbani, S. I., Asdaq, S. M. B., Imran, M., Alshammari, M. K., Alshammari, N. A., Alshahrani, A. H., Harshan, M. A. M., Hurubi, M. Y. A., Mubaraki, A. A., Alamri, A. S., Alsanie, W. F., & Alhomrani, M. (2021, December). Epidemiological determinants for the spread of COVID-19 in Riyadh Province of Saudi Arabia. Saudi Journal of Biological Sciences, https://doi.org/10.1016/j.sjbs.2021.12.032 .

[2] Emami Zeydi, A., Ghazanfari, M. J., Shaikhi Sanandaj, F., Panahi, R., Mortazavi, H., Karimifar, K., Karkhah, S., & Osuji, J. (2021). Coronavirus Disease 2019 (COVID-19): A Literature Review from a Nursing Perspective. BioMedicine, 11(3), Article 2, 5-14. DOI: 10.37796/2211-8039.1154.

pandemic and beyond. Even if for most of the pupils it's not very difficult to adapt to the online school, for the vulnerable categories, this adaptation could be very difficult. More studies regarding the effects of the COVID-19 on children are needed in order to take the correct decisions regarding the opening or the closure of schools (Di Nardo et al (2020)). [3]

Zawbaa et al (2021) recommend lack of social distancing, which has a very powerful effect on the spread, severity and mortality of COVID-19 disease. In the same line, Sigler et al (2021) recommend limiting human mobility in order to reduce Covid-19 spreading, which in the absence of a big vaccination rate may be one of the best ways of epidemiological defense. The results are confirmed by Tantrakarnapa et al (2020) [4], who found out that, in Thailand, the number of tourists and their activities are significantly associated with the number of infected, confirmed COVID-19 cases.

Even if measures such as working from home and self-isolation have good effects for reducing the risk of contracting and spreading the disease, these options are somehow for the privileged category of society and are not applicable to everyone (not every job can be made from home, not everyone can afford to self-isolate, for professional or financial reasons) (Purkayastha et al (2021)). The impact of the pandemics is more severe for the Third World Countries, who are in desperate situations and whose conditions may well further deteriorate because of the restricted measures (Mohamed (2021)). If in the wealthy countries, the population could have resources to resist a period of time in isolation, this is definitely not the case for the deprieved countries. In addition to this, Paremoer et al (2021) [5] concluded that poor and exploitative working and living conditions have increased health risks and enabled inequitable distribution of income.

The aim of this paper is to identify the socio-economic and the cultural determinants of the COVID-19 spreading in the EU countries. To find out the medical, socio-economic and cultural determinants of corona virus spreading, a linear regression using EViews 10 software was performed.

[3] Di Nardo, M., van Leeuwen, G., Loreti, A., Barbieri, M. A., Guner, Y., Locatelli, F., & Ranieri, V. M. (2020). A literature review of 2019 novel coronavirus (SARS-CoV2) infection in neonates and children. Pediatric Research, 89, 1101-1108.

[4] Tantrakarnapa, K., Bhopdhornangkul, B., & Nakhaapakorn, K. (2020, June). Influencing factors of COVID-19 spreading: a case study of Thailand. Nature Public Health Emergency Collection, 1-7. doi: 10.1007/s10389-020-01329-5 .

[5] Paremoer, L., Nandi, S. and Serag, H. (2021, January). Covid-19 pandemic and the social determinants of health. British Medical Journal, 372(n129), doi: https://doi.org/10.1136/bmj.n129 .

The dependent variables are: total cases per million, new cases per million, total deaths per million, new deaths per million. Both total and new cases or deaths were considered to better analyze both the long term and the short term of the corona virus spreading, the per million variant for all variables was taken into consideration to normalize the values and to be able to compare small countries, like Luxembourg and large countries, like Germany.

The EU countries were chosen because they followed similar policies and pandemic approaches, they had access to vaccines by a common mechanism of negotiation and they bought the necessary vaccines from the main producers.

The following type of determinants were considered:

1. Medical and health policies determinants: people fully vaccinated per hundred, total tests per thousand, new tests per thousand, reproduction rate, positivity rate, the stringency index.
2. Socio-economic determinants: GDP per capita, extreme poverty, Human Development Index, median age, life expectancy, aged 65 and older.
3. Cultural determinants: a part of the Hofstede cultural dimensions: individualism, indulgence, long term orientation, masculinity. The other two dimensions (power distance and uncertainty avoidance) were not statistically significant in any of the models.
4. Governance indicators: two of the World Bank Governance Indicators: control of corruption and government effectiveness. The other governance indicators (political stability, regulatory quality, rule of law and voice and accountability) were not statistically significant in any of the models.

The Covid 19 database from *Our World in Data* [6] was used for almost all variables. The cultural variables (individualism, indulgence, long term orientation and masculinity) were found in *Hofstede Insights* [7] database and the governance indicators (control of corruption and government effectiveness) were found in *Worldwide Governance Indicators* [8] from World Bank database. All the mentioned databases contain the necessary indicators

[6] Our World in Data (2021). Retrieved at https://ourworldindata.org .

[7] Hofstede Insights (2021). Retrieved at https://www.hofstede-insights.com .

[8] World Bank. Worldwide Governance Indicators. Retrieved at https://info.worldbank.org/governance/wgi .

for the study, but there were selected only the EU countries with complete data for all the indicators in the mentioned period. These EU countries are: Austria, Belgium, Denmark, Estonia, Finland, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Slovakia and Slovenia.

Aged 65 and older refers to the elderly population. Because older people are considered to be at higher risk for Covid 19, aged 65 and older will have a negative influence on corona virus spreading.

Control of corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as the "capture" of the state by elites and private interests. It involves, but not exclusively: corruption among public officials, public trust of politicians, level of "petty" corruption between administration and citizens etc (World Bank, Worldwide Governance Indicators). [9] The assumption is that countries with a high control of corruption control better the pandemics than countries with a low control of corruption.

Extreme poverty is the most severe form of poverty and it means the deprivation of a person of the basic human needs: food, water, shelter and no access to basic services, like health and education. The World Bank established a poverty line, therefore extreme poverty means an income below 1.90$ per day. Extreme poverty can have either a positive influence on the corona virus spreading, because a person at extreme poverty level cannot afford masks or tests, or a negative influence, because it limits the freedom of movement.

GDP per capita (Gross Domestic Product per capita) is calculated by dividing the GDP of a country by the population of the country and it is used to analyze the prosperity of a country based on its economic growth. GDP per capita provides useful insight and comparison of countries' prosperity, their domestic productivity and their economic development. In countries with higher GDP per capita, the health infrastructure is better, the medical facilities have a higher quality, people respect more the restrictions imposed by their government. GDP per capita is expected to have a negative influence on the corona virus spreading.

Government effectiveness captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation and the credibility of the government's commitment to such policies. It involves, but not exclusively: quality of bureaucracy, quality of road

[9] World Bank. Worldwide Governance Indicators. Retrieved at https://info.worldbank.org/governance/wgi .

infrastructure, satisfaction with public transportation system, public schools etc (World Bank, Worldwide Governance Indicators). [10] The assumption is that countries with a high government effectiveness control better the pandemics than countries with a low government effectiveness.

HDI (Human Development Index) is based on three dimensions: long and healthy life, knowledge and a decent standard of living. For each of the three dimensions, there are indicators: life expectancy for the first dimension, expected years of schooling and mean years of schooling for the second dimension and GNI per capita (PPP) for the last one. Based on the indicators, there are three indices: life expectancy index, education index and GNI index and HDI is the geometric mean of the normalized indices. HDI is expected to have a negative impact on the corona virus spreading.

Individualism means that individuals are expected to take care of only themselves and their immediate families. Its opposite, Collectivism means that individuals are expected to take care of more than themselves and their immediate families, to take care of the others, of the society too. A society's position on this dimension is reflected in whether people's self-image is defined in terms of "I" or "we" (Hofstede Insights). [11] It's expected that the collectivist societies should control better the Covid pandemics than the individualist ones.

Indulgence means that the society allows free gratification of natural human pleasures related to enjoying life and having fun. The opposite, restraint, means that society suppresses the gratification of pleasures and regulates it by means of strict social norms (Hofstede Insights). [12] Indulgence should have a positive influence on the virus spreading. The assumption is that the less indulgent countries have more success in the pandemic fight than the more indulgent countries.

Life expectancy means the average time a person is expected to live according the year of birth, the person's current age and other demographic factors. A country with a high life expectancy has a health infrastructure of high quality and a good level of development. The life expectancy is expected to have a negative impact on corona virus spreading.

Long term orientation versus short term orientation is another cultural dimension, refering to the choice of focusing on people efforts in the future for

[10] World Bank. Worldwide Governance Indicators. Retrieved at https://info.worldbank.org/governance/wgi .

[11] Hofstede Insights (2021). Retrieved at https://www.hofstede-insights.com .

[12] Hofstede Insights (2021). Retrieved at https://www.hofstede-insights.com .

long term orientation and in the present and the past for short term orientation. People from countries with long term orientation adapt to circumstances, learn from other countries, adapt traditions to circumstances. People from countries with short term orientation preserve their traditions, guide their family life by imperatives and are orientated to social spending and consumption (Hofstede Insights). [13] Therefore, a higher score on long term orientation will have a negative impact on the virus spreading.

Masculinity means a preference in society for achievement, heroism, assertiveness, and material rewards for success. Its opposite, Femininity means a preference for cooperation, modesty, caring for the weak and quality of life (Hofstede Insights). [14] Even if, from an economic point of view, a masculine society is more competitive, in a pandemic context, it's expected from feminine societies to control better the Covid pandemics.

Median age is the age which divide a population into two equal groups, meaning half of the population is younger than the median age and the other half is older than the median age. The median age is expected to have a negative impact on corona virus spreading.

The positivity rate is the share of tests returning a positive Covid result. The ability of the positivity rate to control the Covid pandemic depends on the number of tests. If the number of tests is higher, the positivity rate will be more efficient to control the spreading of the Covid. According to WHO criteria, if the positivity rate is smaller than 5%, it means the Covid pandemics is under control in a specific country. WHO considered an adequate testing, when for each confirmed case, between 10 and 30 tests are made. The positivity rate is expected to positively influence the corona virus spreading.

The reproduction rate is an epidemiological metric to measure the transmissibility of a disease, in this case Covid 19, which is estimated when there is zero immunity in the population. It means the number of secondary infections generated by a primary case in the beginning of a pandemics. It depends on the extent of the human to human interaction and that explains the importance of the social distancing in the Covid pandemics. When the reproduction rate is smaller than 1, the disease will perish in the population, but when the reproduction rate is greater than 1, the disease will spread faster. The greater the rate is, the faster it will spread (Achaiah,

[13] Hofstede Insights (2021). Retrieved at https://www.hofstede-insights.com .

[14] Hofstede Insights (2021). Retrieved at https://www.hofstede-insights.com .

Subbarajasetty & Shetty, 2020). [15] The initial reproduction rate of Covid according to WHO was 3, meaning an infected person may infect three other persons in the absence of any measures. But, for the Delta variant, the reproduction rate is between 6 and 9, therefore an infected person may infect twice or even three times more persons than the initial variant, this is why the Delta variant is considered more contagious (Health Desk, 2021). [16] The reproduction rate is expected to have a positive influence on the corona virus spreading.

The stringency index is the average of nine indicators: schools closure, workplace closures, cancellation of public events, restrictions on public gatherings, closure of public transport, stay-at-home requirements, public information campaigns, restrictions on internal movements and international travel controls. Since each of the nine indicators have values from 0 to 100, the stringency index itself will have values between 0 and 100, the higher the value is, the stricter the restrictive measures are respected in a country or region. Therefore, the stringency index is expected to have a negative impact on the corona virus spreading.

Total positive cases refers to total confirmed cases of Covid 19, as reported by each country, new positive cases means daily new confirmed cases of Covid 19, as reported by each country. Similar for total deaths, new deaths, total tests per thousand, new tests per thousand, fully vaccinated people per hundred. To compute a variable per million, for example total positive cases, the total confirmed Covid cases in a specific day is divided by total population of a country using the most recent census and then multiplied by 1000000. Similar per thousand, it means to multiply by 1000 and per hundred to multiply by 100. The reason of using per million or per thousand or per hundred variants is to allow the comparison between countries.

Methods

We have to mention that most of the variables have same values for the days, so we couldn't apply Unit Root Test for these variables. For the rest of the variables, the Cross-Sectionally Independent Im, Pesaran and Shin Test was applied to test the Unit Root. The null hypothesis of individual unit

[15] Achaiah, N. C., Subbarajasetty, S. B., & Shetty, R. M. (2020, November). R_0 and R_e of COVID-19: Can We Predict When the Pandemic Outbreak will be Contained?. Indian Journal of Critical Care Medicine, 24(11), 1125-1127. doi: 10.5005/jp-journals-10071-23649 .

[16] Health Desk (2021, August). How contagious is the Delta variant compared to other infectious diseases?. Retrieved at https://health-desk.org/articles/how-contagious-is-the-delta-variant-compared-to-other-infectious-diseases .

root was rejected at Level for the variables: New Deaths, New Tests per Thousand, Reproduction Rate, Total Positive Cases, Total Deaths and Total Tests per Thousand. The null hypothesis of unit root was rejected at 1st. Difference for the variables: New Positive Cases, People Fully Vaccinated per Hundred, Positivity Rate and Stringency Index. The results for apllying Im, Pesaran and Shin Test for Unit Root are presented in Table 1.

Table 1: The results for Im, Pesaran and Shin Test for Unit Root

	Probability Level	Probability 1st. Difference	Statistic Value of Im, Pesaran and Shin W-stat
New Deaths	0.0000	-	-7.22837
New Positive Cases	0.2901	0.0000	-57.2154
New Tests per Thousand	0.0000	-	-8.61993
People Fully Vaccinated per Hundred	1.0000	0.0000	-17.8684
Positivity Rate	0.4823	0.0000	-10.5340
Reproduction Rate	0.0053	-	-2.55748
Stringency Index	0.9999	0.0000	-23.3470
Total Deaths	0.0000	-	-8.04017
Total Positive Cases	0.0031	-	-2.73721
Total Tests per Thousand	0.0157	-	-2.15128

Source: Author's table based on EViews outputs

The Pesaran CD Test was applied to test the Residual Cross-Section Dependency. The Cross-Section SUR option was applied to remedy the problem of cross-section dependence (correlation) in weighted residuals. The results of Pesaran CD Test were: 0.4062 for *Total Positive Cases*; 0.3713 for *New Positive Cases*; 0.4391 for *Total Deaths*; 0.2616 for *New Deaths*.

The Hausman Test was applied to decide between the options Fixed Effects and Random Effects. The probability is 1.0000 in all cases, so definitely Random Effects were applied. The Lagrange Multiplier Test Two-sided (Breusch-Pagan) was applied too. The result of Breusch-Pagan Test is 0.0108 in all cases, which confirms the option of Random Effects.

As a result of applying Pesaran CD, Hausman and Lagrange Multiplier Tests, the recommended panel options are Cross-section SUR and Period Random. The values of the coefficients of the independent variables, applying these options, are presented in the next section.

Results

Table 2: The coefficients of the independent variables for total positive cases

	Total positive cases Panel EGLS Cross-Section SUR	Total positive cases Panel EGLS Period Random Effects
Aged 65 and Older	299809.7	300312.3
Control of Corruption	5313.232	5224.431
Extreme Poverty	52867.24	50077.97
GDP Per Capita	31.87675	31.83670
Government Effectiveness	-19500.90	-19560.48
Human Development Index	-1650058.	-1536877.
Individualism	-14072.41	-14097.61
Indulgence	461.9584	365.6110
Life Expectancy	-109272.4	-109523.3
Long Term Orientation	418.1068	378.5662
Masculinity	6158.982	6198.957
Median Age	-220369.8	-220239.9
People Fully Vaccinated Per Hundred	315.2422	339.6410
Positivity Rate	-64485.70	-85290.55
Reproduction Rate	-5729.358	-10097.89
Stringency Index	-15.00956	-51.31715
Total Tests Per Thousand	1.164730	1.288077
R square	0.99	0.89

Source: Author's table based on EViews outputs

The following variables have a strong positive influence on total positive cases: aged 65 and older, control of corruption, extreme poverty,

indulgence, long term orientation, masculinity and people fully vaccinated per hundred. The following variables have a strong negative influence on total cases per million: government effectiveness, Human Development Index, individualism, life expectancy, median age, positivity rate and reproduction rate. GDP per capita and total tests per thousand have a positive, but small influence. Stringency index has a negative, but small influence.

Table 3: The coefficients of the independent variables for new positive cases

	New positive cases Panel EGLS Cross-Section SUR	New positive cases Panel EGLS Period Random Effects
Aged 65 and Older	-813.9599	-862.6116
Control of Corruption	-11.59165	-13.52977
Extreme Poverty	Not statistically significant	Not statistically significant
GDP Per Capita	-0.076583	-0.081081
Government Effectiveness	53.00960	55.67944
Human Development Index	Not statistically significant	Not statistically significant
Individualism	36.34714	38.44581
Indulgence	Not statistically significant	Not statistically significant
Life Expectancy	303.9544	323.6013
Long Term Orientation	2.703201	2.683677
Masculinity	-18.78509	-19.86619
Median Age	597.9380	638.4943
New Tests Per Thousand	1.719297	2.447345
People Fully Vaccinated Per Hundred	-0.256813	-0.635523
Positivity Rate	4090.259	4130.605
Reproduction Rate	65.24662	66.59194
Stringency Index	-0.477416	-1.132745
R square	0.75	0.70

Source: Author's table based on EViews outputs

The situation is quite different from total positive cases. As expected, life expectancy, median age and positivity rate have a strong positive influence on new cases per million. Surprinsingly, aged 65 and older has a strong negative influence on new cases per million, in total contradiction to

total positive cases. Government effectiveness, indulgence and reproduction rate have a positive, but not very big influence. The influence of control of corruption and masculinity is negative, but not very big too. The influence of GDP per capita, long term orientation, new tests per thousand, people fully vaccinated per hundred and stringency index is very low, almost unnoticed. And extreme poverty, Human Development Index and indulgence are not statistically significant.

Table 4: The coefficients of the independent variables for total deaths

	Total deaths Panel EGLS Cross-Section SUR	Total deaths Panel EGLS Period Random Effects
Aged 65 and Older	9615.450	9542.159
Control of Corruption	197.9783	194.3314
Extreme Poverty	1278.957	1197.407
GDP Per Capita	1.006379	1.000439
Government Effectiveness	-730.5790	-726.2169
Human Development Index	-40567.18	-38002.30
Individualism	-446.6917	-444.2442
Indulgence	33.76991	31.79217
Life Expectancy	-3676.440	-3646.969
Long Term Orientation	-3.397060	-3.711963
Masculinity	210.9599	209.5712
Median Age	-6934.072	-6860.368
People Fully Vaccinated Per Hundred	2.158303	1.448315
Positivity Rate	-2079.202	-2739.658
Reproduction Rate	-85.72975	-206.1620
Stringency Index	-2.912442	-6.097893
Total Tests Per Thousand	0.055558	0.054040
R square	0.99	0.94

Source: Author's table based on EViews outputs

The variables with a strong positive influence on total deaths are: aged 65 and older, control of corruption, extreme poverty, indulgence and masculinity. The variables with a strong negative influence on total deaths are: government effectiveness, Human Development Index, individualism, life expectancy, median age, positivity rate and reproduction rate. The influence of GDP per capita, long term orientation, people fully vaccinated per hundred, stringency index and total tests per thousand is very small.

Table 5: The coefficients of the independent variables for new deaths

	New deaths Panel EGLS Cross-Section SUR	New deaths Panel EGLS Period Random Effects
Aged 65 and Older	18.83542	20.46855
Control of Corruption	0.572507	0.544533
Extreme Poverty	11.58857	10.91585
GDP Per Capita	0.002067	0.002174
Government Effectiveness	-1.306351	-1.402658
Human Development Index	-348.2232	-310.7192
Individualism	-0.850529	-0.913779
Indulgence	0.308691	0.257547
Life Expectancy	-7.238524	-7.775570
Long Term Orientation	0.024549	Not statistically significant
Masculinity	0.355986	0.390730
Median Age	-15.31201	-16.53377
New Tests Per Thousand	0.042361	0.084861
People Fully Vaccinated Per Hundred	-0.011178	Not statistically significant
Positivity Rate	62.75413	65.21489
Reproduction Rate	-0.853227	-1.143578
Stringency Index	0.061672	0.092685
R square	0.72	0.71

Source: Author's table based on EViews outputs

The situation is rather different from the other cases. A lot of variables have a very low influence, almost unnoticed: control of corruption, GDP per capita, government effectiveness, individualism, indulgence, masculinity, new tests per thousand, reproduction rate and stringency index. Aged 65 and older and extreme poverty have a positive influence, but not very big. Life expectancy and median age have a negative influence, but relatively small too. Long term orientation and people fully vaccinated per hundred are not statistically significant. The only influent variables in this case are the positivity rate (strong positive influence) and the Human Development Index (strong negative influence).

A separate analysis was conducted by countries. In this case, the results are totally different. Only 5 indicators were analyzed: people fully vaccinated per hundred, positivity rate, reproduction rate, stringency index

and total tests per thousand / new tests per thousand. All of the other indicators were not statistically significant in any of the cases, so they were not included in the analysis. The results are presented in the next tables:

Table 6: The coefficients of the independent variables by country for total positive cases

	People fully vaccinated per hundred	Positivity rate	Reproduction rate	Stringency index	Total tests per thousand
Austria	-1055.758	Not statistically significant	2326.184	Not statistically significant	12.64041
Belgium	-355.4071	-10921.91	-3557.703	-31.49880	74.66695
Denmark	94.33042	58645.57	-1586.263	-30.96517	3.480123
Estonia	-1187.460	-15835.17	Not statistically significant	158.5652	177.5477
Finland	Not statistically significant	49338.00	-3437.993	88.37685	22.38588
Greece	371.7881	252680.1	-10384.05	-292.1645	4.499446
Hungary	65.56886	104808.3	-34280.23	-899.8368	8.080467
Ireland	Not statistically significant	31739.12	-3746.845	161.2666	45.33555
Italy	-334.1474	48157.73	Not statistically significant	Not statistically significant	65.90387
Latvia	-265.8781	-34379.67	-7026.522	53.85018	44.24382
Lithuania	-823.9711	-23140.98	887.1226	Not statistically significant	85.75875
Malta	-189.3752	Not statistically significant	263.0551	174.2481	48.43649
Poland	Not statistically significant	66302.23	-29467.19	-733.9203	48.65566

Portugal	106.8351	-28059.93	-7183.537	Not statistically significant	17.87021
Slovakia	-98.81121	Not statistically significant	Not statistically significant	81.63770	4.489879
Slovenia	-410.6881	3864.303	-2069.578	-40.54215	209.3941

Source: Author's table based on EViews outputs

For people fully vaccinated per hundred, positivity rate and stringency index, the results are different. People fully vaccinated per hundred has a strong positive influence on total positive cases in Denmark, Greece, Hungary and Portugal and a strong negative influence in Austria, Belgium, Estonia, Italy, Latvia, Lithuania, Malta, Slovakia and Slovenia. It's not statistically significant in Finland, Ireland and Poland. Positivity rate has a strong positive influence in Denmark, Finland, Greece, Hungary, Ireland, Italy, Poland and Slovenia and a strong negative influence in Belgium, Estonia, Latvia, Lithuania and Portugal. It's not statistically significant in Austria, Malta and Slovakia. Stringency index has a strong positive influence in Estonia, Finland, Ireland, Latvia, Malta and Slovakia and a strong negative influence in Belgium, Denmark, Greece, Hungary, Poland and Slovenia. It's not statistically significant in Austria, Italy, Lithuania and Portugal. In most of the countries, the reproduction rate has a negative influence, the strongest negative influence it's in Ireland, Poland and Greece. As expected, total tests per thousand has a positive influence in all the countries. The bigger number of tests are conducted, the bigger number of positive cases is. The strongest positive influence is in Slovenia, Estonia and Lithuania.

Table 7: The coefficients of the independent variables by country for new positive cases

	New tests per thousand	People fully vaccinated per hundred	Positivity rate	Reproduction rate	Stringency index
Austria	1.438892	0.810960	32402.47	Not statistically significant	Not statistically significant
Belgium	21.75215	Not statistically significant	3686.250	Not statistically significant	Not statistically significant
Denmark	3.286147	Not	11091.32	63.55393	Not

		statistically significant			statistically significant
Estonia	41.82872	Not statistically significant	4688.182	Not statistically significant	Not statistically significant
Finland	8.588835	Not statistically significant	3604.137	Not statistically significant	Not statistically significant
Greece	13.52434	3.313631	4589.609	Not statistically significant	1.897845
Hungary	102.7432	Not statistically significant	2950.452	Not statistically significant	-4.210723
Ireland	25.78927	Not statistically significant	3991.344	70.70553	Not statistically significant
Italy	24.95169	-0.617897	4143.322	44.54343	Not statistically significant
Latvia	27.35303	-2.336256	4160.141	45.73295	Not statistically significant
Lithuania	16.38449	-3.792421	4659.088	Not statistically significant	-6.573499
Malta	21.51651	-0.851670	5772.990	33.50754	-1.893191
Poland	159.9433	Not statistically significant	1957.659	Not statistically significant	-4.766521
Portugal	7.833520	2.041269	3135.276	92.85510	1.760839
Slovakia	Not statistically significant	Not statistically significant	22265.50	Not statistically significant	2.556218
Slovenia	73.43012	Not statistically significant	729.2313	Not statistically significant	3.255418

Source: Author's table based on EViews outputs

As expected, new tests per thousand has a positive influence in all the countries, except Slovakia, where is not statistically significant. The strongest

positive influence is in Poland, Hungary and Slovenia. People fully vaccinated per hundred is not statistically significant in most of the analyzed countries (Belgium, Denmark, Estonia, Finland, Hungary, Ireland, Poland, Slovakia and Slovenia) and in the other countries the influence is relatively low. As expected, the positivity rate has a strong positive influence in all the countries, as higher as the positivity rate, as bigger as the number of new positive cases is. The strongest positive influence is in Austria, Slovakia and Denmark. The reproduction rate is not statistically significant in most of the countries, but it has a strong positive influence in Denmark, Ireland, Italy, Latvia, Malta and Portugal. Stringency index is not statistically significant in Austria, Belgium, Denmark, Estonia, Finland, Ireland, Italy and Latvia. In the other countries, the influence is relatively low.

Table 8: The coefficients of the independent variables by country for total deaths

	People fully vaccinated per hundred	Positivity rate	Reproduction rate	Stringency index	Total tests per thousand
Austria	-12.00202	-1706.773	33.89175	-0.470341	0.136481
Belgium	-355.4071	-10921.91	-3557.703	-31.49880	74.66695
Denmark	-0.518396	571.7797	6.417174	-0.264229	0.014380
Estonia	-14.08107	-830.2094	44.66897	0.508957	1.724614
Finland	-0.099859	-45.54422	-5.029405	0.979428	0.122286
Greece	3.405222	6393.787	-183.6407	-12.47185	0.102381
Hungary	2.492617	2020.824	-1163.353	-30.88375	0.291910
Ireland	Not statistically significant	-1725.830	65.68301	4.441893	0.661481
Italy	-7.556316	-372.5833	19.14799	Not statistically significant	1.364114
Latvia	-4.270136	-1522.998	-83.47804	-1.102140	0.663909
Lithuania	-12.77154	-1226.776	63.59187	Not statistically significant	1.213305
Malta	-1.628690	-1118.967	17.25413	2.622084	0.414800
Poland	Not statistically	910.1939	-638.9316	-19.26764	1.008735

	significant				
Portugal	0.932327	-1732.668	-29.41446	0.323200	0.104618
Slovakia	-4.753572	Not statistically significant	49.11646	1.353568	0.253578
Slovenia	-4.256738	-119.3842	Not statistically significant	-0.392368	1.833065

Source: Author's table based on EViews outputs

As expected, people fully vaccinated per hundred has a negative influence in most of the countries. As higher as the vaccination rate is, as smaller as the number of total deaths is. The strongest negative influence is in Belgium, Estonia, Lithuania, and Austria. The positivity rate and the reproduction rate have a negative influence too. For positivity rate, the strongest negative influence is in Belgium, Portugal, Ireland, and Austria and for the reproduction rate, the strongest negative influence is in Belgium, Hungary, and Greece. This is strongly correlated with the vaccination rate. Even if the positivity rate and the reproduction rate of the virus are high, if the vaccination rate is high too, the number of total deaths will be low. As expected, stringency index has a negative influence in most of the countries. As severe as the restrictions are, as lower as the number of total deaths is. The strongest negative influence is in Belgium, Hungary, and Poland. As expected, total tests per thousand has a positive influence in all the countries. The strongest influence is in Belgium, Slovenia, and Estonia.

Table 9: The coefficients of the independent variables by country for new deaths

	New tests per thousand	People fully vaccinated per hundred	Positivity rate	Reproduction rate	Stringency index
Austria	0.012562	-0.019937	208.3196	Not statistically significant	Not statistically significant
Belgium	Not statistically significant	-0.022588	23.92290	Not statistically significant	0.031249
Denmark	-0.026712	Not statistically significant	38.31369	Not statistically significant	0.075112

Estonia	Not statistically significant	Not statistically significant	30.24911	Not statistically significant	0.087674
Finland	0.130832	Not statistically significant	8.710499	Not statistically significant	Not statistically significant
Greece	Not statistically significant	-0.044801	122.4829	-3.495989	Not statistically significant
Hungary	Not statistically significant	Not statistically significant	114.2289	-7.547536	-0.074681
Ireland	1.031420	Not statistically significant	Not statistically significant	-7.893935	Not statistically significant
Italy	0.293728	-0.055690	72.71107	Not statistically significant	Not statistically significant
Latvia	0.467736	Not statistically significant	112.1509	-3.339484	Not statistically significant
Lithuania	Not statistically significant	-0.046200	55.53788	-1.837443	-0.031129
Malta	Not statistically significant	-0.023009	40.45153	Not statistically significant	Not statistically significant
Poland	6.094276	Not statistically significant	Not statistically significant	Not statistically significant	0.209622
Portugal	Not statistically significant	-0.070421	138.4029	-0.842347	-0.046470
Slovakia	Not statistically significant	-0.189328	366.9141	Not statistically significant	0.199004
Slovenia	Not statistically significant	-0.098860	Not statistically significant	Not statistically significant	Not statistically significant

Source: Author's table based on EViews outputs

New tests per thousand, people fully vaccinated per hundred and stringency index are not statistically significant in most of the countries and in the rest of them the influence is relatively low. The positivity rate has a strong positive influence in almost all the countries. The strongest positive influence is in Slovakia, Austria, and Portugal. The reproduction rate has a negative influence in Greece, Hungary, Ireland, Latvia, Lithuania, and Portugal. In the other countries is not statistically significant.

Discussion

As expected, the population over 65 has a strong, positive influence on total positive cases, total deaths and new deaths, this age category being the most vulnerable. The results are in line with those of Al-Yamani et al (2021).

The control of corruption has a strong positive influence on total cases and total deaths, because the countries with a good control of corruption conduct a big number of tests and they declare the real number of cases and the real number of deaths, they won‘t disguise the reality. The countries with a weak control of corruption conduct a smaller number of tests and often they don’t declare the real numbers. For new positive cases, the control of corruption has a negative, but relatively small influence.

Extreme poverty has a strong positive influence on total cases, total deaths and new deaths. So, the poor countries are the most exposed, partially because of their poor medical infrastructure and partially because, in the poor countries, people are not willing to respect the restrictions, they put the financial safety on the first place and they continue to go physically to work despite of the medical risks. This facilitates the spread of the virus and, having a poor medical system, lots of cases are deadly. The results for the extreme poverty confirm the findings of Paremoer et al (2021).

The GDP per capita has a small influence in all the cases, so the number of Covid-19 cases and deaths doesn’t depend radically on the level of GDP per capita. The results are in contradiction with those of Purkayastha et al (2021).

As expected, the government effectiveness has a strong negative influence on total cases and total deaths. So, the number of positive cases and the number of deaths is directly corelated with the effectiveness of the government. For new positive cases, the government effectiveness has a positive, but relatively small influence.

Human Development Index has a strong negative influence on total positive cases, total deaths and new deaths, so the developed countries can control the pandemics better than the less developed ones. An explanation could be that, in the developed countries, people could have the financial

resources to put health on the first place and to respect the restrictions and the necessary technology for working remote and for online schooling. In addition, the developed countries usually have solid health systems, so the mortality rate is low. The results for Human Development Index confirm the findings of Paremoer et al (2021).

As expected, individualism has a strong negative influence on total positive cases and on total deaths. This confirms the hypothesis that the collectivist cultures control the pandemics better than the individualist ones. For new positive cases, individualism has a positive, but relatively small influence. The results for individualism are in line with those of Sigler et al (2021), who recommend limiting human mobility in order to reduce Covid-19 spreading.

As expected, the indulgence degree has a positive influence on total positive cases, total deaths and new deaths. This confirms the hypothesis that the countries more interested in human pleasures have more positive cases and more deaths than the countries more interested in health. The results for indulgence are according to Tantrakarnapa et al (2020), who found out that the number of tourists and their activities are significantly associated with the number of confirmed COVID-19 cases in Thailand.

Life expectancy has a strong negative influence on total positive cases, total deaths and new deaths. The higher the life expectancy is, the smaller the number of positive cases is. The countries with high life expectancies usually have very strong health systems, so most of the infected persons would get proper treatment and care, so the majority of cases are not deadly. The results for life expectancy are in line with those of Harapan et al (2020).

Long term orientation has a positive influence on total positive cases and on new positive cases, but a negative influence on total deaths. Even if long term oriented countries have a big number of positive cases because they do not impose strict restrictions from economic reasons, having strong health systems, they can treat well the COVID patients, so most of the cases are not deadly. The results are in line with those of Emami Zeydi et al (2021).

Masculinity has a strong positive influence on total positive cases and on total deaths. This confirms the hypothesis that, even if the masculine cultures are more competitive from an economic point of view, they are less competitive in controlling the pandemics. For new positive cases, masculinity has a negative sign, but the influence is relatively small. The results are in line with those of Purkayastha et al (2021).

Median age has a strong negative influence on total positive cases, total deaths and new deaths, but a positive influence on new positive cases. Usually, median age includes categories like employees 35-45 years old.

Even if this category is the most active one, because they have to go daily to work and they have big chances to contact the virus, they are usually less vulnerable people, with a good natural immunity, so the chances to have a severe form and to die because of the disease are low. The results for median age are according to those of Al-Yamani et al (2021).

One of the most unexpected result is the positive influence of people fully vaccinated per hundred on total deaths. At first sight, this result could be surprising, because you are tempted to think that a big vaccination rate means a small number of deaths. This is true, but, if the majority of the population of a country is vaccinated (case of Portugal, for example), mathematically, there are bigger chances that the deadly cases to be from a majority of over 90% than from a minority of 6-7%. By country, this is happen in Portugal, Greece and Hungary.

As expected, the positivity rate has a strong positive influence on new deaths. Mathematically, if the positivity rate is high, there are good chances to have a bigger number of new deaths. By country, the strongest positive influence on new deaths is in Slovakia, Austria and Portugal.

The reproduction rate has a negative influence on total deaths and on new deaths. It is strongly correlated with the vaccination rate. Even if the reproduction rate of the virus is high, if the vaccination rate is high too, the number of deadly cases will be low. By country, this is proved in Belgium, Hungary and Greece.

The stringency index has a negative influence on total positive cases, new positive cases and on total deaths. Probably, the most important measure to reduce the number of cases and the number of deaths is the schools closure. Strictly from a medical point of view, the findings for the schools closure are in line with those of Di Nardo et al (2020), who consider that more studies regarding the effects of the COVID-19 on children are needed in order to take the correct decisions regarding the schools closure. In the same line, Zawbaa et al (2021) recommend lack of social distancing in order to reduce the number of positive cases and deaths. By country, stringency index has a strong negative influence in Belgium, Denmark, Greece, Hungary, Poland and Slovenia.

As expected, total tests per thousand / new tests per thousand has a positive influence in all the cases. The bigger number of tests are conducted, the bigger number of positive cases, part of them deadly, is. By country, the strongest positive influence is in Slovenia, Estonia and Lithuania. The results are in line with those of Harapan et al (2020).

Conclusions

To conclude, we can see that, for most of the variables, the trend for total positive cases and total deaths is almost the same, except for long term orientation, median age and reproduction rate. Even if these variables mean a big number of positive cases, the high vaccination rate and the strong health systems in the developed countries make the difference between positive and deadly. For some variables, for new positive cases, the trend is opposite to total positive cases, but the influence is relatively small. For new deaths, most of the variables have a very small influence, the only two influent variables being the positivity rate (strong positive influence) and the Human Development Index (strong negative influence).

The originality of the paper consists of using a mix of determinants, including medical and health policies, cultural, socio-economic and governance determinants of the COVID-19 spreading. The limitations of the study are considering the EU countries only and not including other governance determinants and the political ones. Further research should be conducted, by analyzing the pandemic waves separately and by including more determinants related to the health infrastructure, governance, as well as political ones.

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