

# The Institutional and Cultural Context of Cross-National Variation in COVID-19 Outbreaks

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**Background.** The COVID-19 pandemic poses an unprecedented and cascading threat to the health and economic prosperity of the world's population.

**Objectives.** To understand whether the institutional and cultural context influences the COVID-19 outbreak.

**Methods.** At the ecological level, regression coefficients are examined to figure out contextual variables influencing the pandemic's exponential growth rate across 96 countries.

**Results.** While a strong institutional context is negatively associated with the outbreak ( $B = -0.55 \dots -0.64, p < 0.001$ ), the pandemic's growth rate is steeper in countries with a quality education system ( $B = 0.33, p < 0.001$ ). Countries with an older population are more affected ( $B = 0.46, p < 0.001$ ). Societies with individualistic (rather than collectivistic) values experience a flatter rate of pathogen proliferation ( $B = -0.31, p < 0.001$ ), similarly for higher levels of power distance ( $B = -0.32, p < 0.001$ ). Hedonistic values, that is seeking indulgence and not enduring restraints, are positively related to the outbreak ( $B = 0.23, p = 0.001$ ).

**Conclusions.** The results emphasize the need for public policy makers to pay close attention to the institutional and cultural context in their respective countries when instigating measures aimed at constricting the pandemic's growth.

## Introduction

As of March 21, 2020, more than 271364 cases of coronavirus disease 2019 (COVID-19) were confirmed worldwide. Italy, then the second most impacted country with 47021 confirmed cases, recorded its first three cases only on January 31, 2020.<sup>1</sup> Efforts to completely contain the new virus largely failed. As a consequence of global mobility and trade, people carrying the virus arrive in countries without ongoing transmission. Governments are currently scrambling to put in

31 unprecedented measures to flatten the curve, because the faster the infection curve rises, the  
32 quicker the national health care systems get overloaded beyond their capacity of treating people  
33 effectively. While ultimately the same number of people are likely to get infected, reducing the  
34 initial number of cases would make the outbreak easier to control overall.<sup>2</sup>

35 In this study, I examine cross-national variation in COVID-19 outbreaks in 96 countries to analyze  
36 the impact of global connectivity, national institutions, socio-demographic characteristics, and  
37 cultural values on the initial arc of the curve. While getting to know the epidemic through, inter-  
38 alia, mathematical models is important for national and international countermeasures, experience  
39 from HIV shows that politics and ideology are often far more influential than evidence and best  
40 practice guidance.<sup>3</sup> It is well acknowledged that politics is central to policy-making in health  
41 generally, and that the institutional and cultural context plays a defining role in health policy  
42 outcomes. With the H1N1 2009 influenza pandemic, social determinants of health affected  
43 outcomes beyond clinically recognized risk factors.<sup>4</sup> Thus, getting to know the national context of  
44 the COVID-19 pandemic will be essential in informing the development of evidence-based  
45 measures.

## 46 **Model and method**

47 I implemented a linear regression model, in which the exponential growth rate of confirmed  
48 COVID-19 cases is regressed on institutional, socio-demographic, and cultural variables  
49 associated with testing and reporting cases, supporting the pathogen's path, and controlling the  
50 outbreak. As of March 21, 2020, there is sufficient COVID-19 outbreak data to estimate the model  
51 for 96 countries. All variables are detailed in Table 1. The aim of this ecological approach is to  
52 study health in an environmental context.<sup>5</sup>

## 53 **Outbreak data**

54 In this study, I use data from the European Center for Disease Control and Prevention (ECDC),  
55 which is an EU agency established in 2005 with the aim to strengthen Europe's defense against  
56 infectious diseases. The ECDC collects and harmonizes data from around the world, thus providing  
57 a global perspective on the evolving pandemic; the datafile is available via Our World in Data, an  
58 effort by the University of Oxford and Global Change Data Lab.<sup>1</sup> Note that the World Health  
59 Organization (WHO) changed their cutoff time on March 18, 2020, and, due to overlaps, their data  
60 is not suitable for understanding the pandemic's development over time beyond this date.<sup>1</sup> To have

61 enough datapoints for estimating the relative growth rate (dependent variable GROWTH) in an  
62 exponential population model, I only include countries which have reported their first case on or  
63 before March 12, 2020, as per the ECDC dataset. With a change point analysis using the Fisher  
64 discriminant ratio as a kernel function, I confirm that the first reporting date is in fact the start of  
65 the outbreak.<sup>6</sup> Accordingly, there are no later significant change points in the outbreak.

#### 66 [Testing and reporting cases](#)

67 During the current COVID-19 outbreak, practically all countries are struggling to test every person  
68 who should be tested from a medical standpoint. Under the guidelines of most countries, clinicians  
69 will test suspected patients only if they have travelled to an epidemic region.<sup>7</sup> The more tests a  
70 country performs, the more confirmed cases it tends to have. Because data on the number of tests  
71 performed is neither comparable across countries (it may refer to tests or individuals) nor updated  
72 regularly,<sup>1</sup> I introduce variables into the regression model, which could purportedly be associated  
73 with a country's capability and commitment to test and report. First, I use a perception indicator  
74 about the functioning of political institutions (independent variable POLINS; 0 = widespread  
75 irregularities to 4 = perfectly fair) from the 2016 edition of the International Profiles Database  
76 (IPD), which is a survey conducted by the French Directorate General of the Treasury.<sup>8</sup> Second, I  
77 calculate the time between Jan 01, 2020 (as a rather random starting point) and discovering the  
78 first case (independent variable DISCOV). This time lag helps a country to learn from others'  
79 experiences, and ramp up their own testing capabilities. As this is likely a non-linear effect, I  
80 logarithmically transform this measure in the regression model.

#### 81 [Interconnectivity between populations](#)

82 Because international connectivity between countries increases the potential spread of a pathogen,<sup>9</sup>  
83 I introduce the independent variable IMPORT, which represents the value of all goods and other  
84 market services received by a country from the rest of the world (year 2017; in bn USD; based on  
85 data from the World Bank).<sup>10</sup> Additionally, with the logged variable DNSITY, I capture a  
86 country's population density, which is defined as all residents in a country divided by land area in  
87 square kilometers (year 2018; data from the World Bank).<sup>11</sup>

#### 88 [Institutional context](#)

89 Because strong stakeholder processes can bring benefits to accepting decisions being made by the  
90 government,<sup>12,13</sup> I use an indicator on participation of the population in political institutions from  
91 the IPD database (independent variable PARPOP; 0 = very low to 4 = strong participation).<sup>8</sup>

92 Second, the society's openness can be described by the freedom of access to foreign information  
93 (independent variable FREEINF; 0 = no to 4 = total freedom; from IPD).<sup>8</sup> Third, the functioning  
94 of the public administration is, inter alia, mirrored in the level of corruption (independent variable  
95 CORRUP; 0 = high to 4 = very low level of corruption; from IPD).<sup>8,14</sup>

#### 96 [Socio-demographic mapping](#)

97 Variable EDUCAT is a logged indicator of an education system's performance, calculated as the  
98 gross intake ratio to the last grade of primary education (average of years 2000 to 2018; data from  
99 the World Bank).<sup>15</sup> And as older people (especially in Italy) seem to get hit more frequently by  
100 COVID-19,<sup>16</sup> I introduce AGEMED as an independent variable for a country's median age  
101 (current data from the CIA World Factbook).<sup>17</sup>

#### 102 [Cultural variables](#)

103 Given that culture determines the values and behaviors of societal members,<sup>18</sup> specific behavioral  
104 manifestations of culture can influence the transmission of pathogens.<sup>19</sup> Although country  
105 boundaries are not strictly synonymous with cultural boundaries, there is abundant evidence that  
106 geopolitical regions can serve as useful proxies for culture.<sup>19</sup> Thus, I use scores from Hofstede's  
107 dimensional framework of culture,<sup>18</sup> available for 73 countries included in my analysis.  
108 Individualism (independent variable INDLSM, score of 1 to 100) is defined as a preference for a  
109 loosely-knit social framework, whereas collectivism (low scores on the same variable) represents  
110 a preference for a tightly-knit framework, in which individuals expect members of a particular  
111 ingroup to look after each other in exchange for unquestioning loyalty. Previous studies have  
112 shown that the regional prevalence of pathogens is negatively associated with individualism.<sup>19</sup>  
113 Power distance (independent variable POWDIS, score of 1 to 100) expresses the degree to which  
114 the less powerful members of a society accept and expect that power is distributed unequally, with  
115 the fundamental issue being how societies handle inequalities among its members. Accordingly,  
116 the norm in countries with high values of POWDIS is the belief that everyone should have a  
117 defined place within the social order. The epidemiology of infections has been shown to be linked  
118 to power distance, but results are not conclusive.<sup>20</sup> In low power distance cultures, people are less  
119 willing to accept directions from superiors,<sup>21</sup> with potentially detrimental effects on controlling the  
120 outbreak of a pandemic. Conversely, in consumer research, country-level high power distance  
121 results in weaker perceptions of responsibility to aid others in a charitable way.<sup>22</sup> Lastly, the  
122 dimension of indulgence (independent variable INDULG, score of 1 to 100) reflects hedonistic

123 societies that allow people to enjoy life and have fun, as compared to societies where restraint is  
124 emphasized. It can be assumed that countries scoring high on the indulgence dimension will have  
125 more difficulty constraining social activity, implementing social distancing measures, and thereby  
126 restricting its citizens' satisfying activities.

## 127 **Statistical results**

128 To test the association of the context variables on the growth rate of COVID-19, I use linear  
129 regression with pairwise exclusion of missing values. The results suggest that a significant  
130 proportion of the total variation of the outbreak can be explained by the context variables,  
131  $F(12,55) = 26.16, p < 0.001$ . Multiple  $R^2$  indicates that 85.09% of the variation in growth can be  
132 predicted by the context variables; estimated power to predict multiple  $R^2$  is at the maximum of  
133 1.000, as calculated with G\*Power 3.1. Table 2 expounds the regression coefficients.

134 Multicollinearity in epidemiological studies can be a serious problem, being a result of  
135 unrepresentative samples or insufficient information in samples, that is not enough countries or  
136 omission of relevant variables.<sup>23</sup> I have conducted several diagnostics to eliminate  
137 multicollinearity issues in the regression analysis. First, the VIF never exceeds 4 (see Table 2),  
138 which is well below the recommended threshold of  $\frac{1}{1-R^2} = 6.70$ . Second, the highest correlation  
139 coefficient is 0.683 between variables DISCOV and IMPORT, which is below the typical cutoff  
140 of 0.8. Only another two correlation coefficients are above the 0.5 cutoff (EDUCAT and  
141 AGEMED: -0.56; POLINS and FEEINF: -0.58). Third, the variance-decomposition matrix does  
142 not show any groups of predictors with high values. In summary, a multicollinearity problem can  
143 be excluded.

144 Further, I conduct several tests to assess the robustness of the results by including other contextual  
145 variables. But because it is nearly impossible to establish a complete list of such confounding  
146 variables, I additionally quantify the potential impact of unobserved confounds (Table 2, column  
147 Impact threshold).<sup>24</sup> For instance, the necessary impact of such a confound for the variable  
148 DISCOV would be 0.80, that is, to invalidate the inference that the time lag has on the growth rate,  
149 a confounding variable would have to be correlated with both GROWTH and DISCOV at  $\sqrt{0.80} =$   
150 0.89, which is a strong correlation. Next, to alleviate concerns that the worldwide spread of the  
151 virus is not yet fully known and that this study might have been conducted too early in the  
152 pandemic, I ask how many countries would have to be replaced with unobserved cases for which

153 the null hypothesis is true (i.e., the contextual variables have no influence on the growth rate) in  
154 order to invalidate the inference.<sup>25</sup> As Table 2 (column Confound threshold) shows, about 86% of  
155 the countries would have to be replaced with countries for which the effect is zero in order to  
156 invalidate the influence of DISCOV. In summary, it can be claimed that the influence of the  
157 identified contextual variables on the pandemic's growth rate is reasonably robust.

## 158 **Discussion**

159 As expected, countries with functioning political institutions (POLINS) report a higher relative  
160 growth rate of the outbreak, probably due to a better testing and reporting infrastructure. Likewise,  
161 for countries that have been hit by the outbreak at a later point of time (DISCOV). The scatterplot  
162 in Figure 1 graphically depicts the relationship between discovery of the first case and the rate of  
163 the outbreak. In this diagram every dot represents a country; Turkey shows up as an outlier having  
164 reported their first case only on March 12, 2020,<sup>2</sup> but showing a very rapid outbreak. International  
165 connectivity as measured by a country's import volume (IMPORT) elevates the growth rate  
166 (Figure 2). Contrary to expectations, population density (DNSITY) is negatively related to the  
167 outbreak. Maybe people in densely populated countries are more likely to adhere to precautionary  
168 measures because they realize the danger of physical closeness to pathogen transmission?<sup>26</sup> Or  
169 does this indicate that social distancing measures are more effective in crowded places? Yet, the  
170 DNSITY coefficient is not statistically significant in the regression model, and the confound  
171 threshold is rather low ( $p = 0.105$ , confound threshold 17.28%). A strong institutional context is  
172 negatively associated with the outbreak, as measured by participation in political institutions  
173 (PARPOP), access to foreign information (FREEINF), and absence of corruption (CORRUP).  
174 Rather surprisingly and contrary to the experience with HIV,<sup>27</sup> the quality of a country's education  
175 system is positively associated with the outbreak. Do people believe that the pathogen affects only  
176 poor countries, and therefore do not take precautionary measures seriously? Or do better educated  
177 people test more due to increased awareness? Providing a conclusive reasoning at this point in the  
178 COVID-19 outbreak is not possible, and I encourage further research in the months or years to  
179 come.

180 Whilst potentially controversial, an association between cultural characteristics and the outbreak  
181 of the pandemic should not be totally surprising, since implementing countermeasures is ultimately  
182 behavioral science.<sup>28</sup> The data shows that individualistic societies experience a lower outbreak  
183 growth rate, which is in line with previous studies about pathogen proliferation.<sup>19</sup> People in more

184 collectivistic cultures apparently find it more difficult to engage in social distancing practices. And  
185 because the effectiveness of social distancing measures has rarely been assessed before,<sup>26</sup> this calls  
186 for a cross-cultural investigation in further research. Higher levels of power distance are associated  
187 with a lesser growth rate of the outbreak; it appears that individuals in low power distance cultures  
188 are less willing to blindly accept directions from the government on how to change their social  
189 behavior.<sup>21</sup> Instead, they prefer a say in decisions affecting their lifestyle. Even though managing  
190 individuals' obstinate behavior is quite a challenge in a pandemic, politicians in low-power  
191 distance countries need to work more towards achieving a buy-in of their electorate. Lastly, a  
192 country's hedonistic tendency towards indulgence and not accepting restraints is positively linked  
193 to the outbreak.

194 My study indicates that governments need to tailor their strategies for combating the COVID-19  
195 pandemic to the institutional and cultural context in their respective countries. In addition to system  
196 change, culture change, that is, the establishment of new norms and behavior, is needed.<sup>28</sup> This  
197 change needs to be driven by leaders showing unequivocal and explicit support for outbreak  
198 control policies and their implementation, hopefully bringing the outbreak under control and  
199 reducing its overall magnitude. This is especially important because the unpredictable future of  
200 the pandemic will be exacerbated by public's misunderstanding of health messages,<sup>29</sup> causing not  
201 only worry but likely also mental health issues in the population.

202

### 203 [Conflict of interest](#)

204 The author declares that there is no conflict of interest.

205

### 206 [Human participant protection](#)

207 No humans participated in this study. The data used for the regression model in this study is  
208 available in its entirety in Table 1. The original data sources are referenced in the section Model  
209 and methods.

210

211 **References**

- 212 1. Roser M, Ritchi H, Ortiz-Ospina E. Coronavirus disease (COVID-19) - Statistics and  
213 research. OurWorldInData.org. <https://ourworldindata.org/coronavirus>. Published 2020.  
214 Accessed March 21, 2020.
- 215 2. Hellewell J, Abbott S, Gimma A, et al. Feasibility of controlling COVID-19 outbreaks by  
216 isolation of cases and contacts. *Lancet Glob Heal*. 2020:488-496. doi:10.1016/s2214-  
217 109x(20)30074-7
- 218 3. Buse K, Dickinson C, Sidibé M. HIV: Know your epidemic, act on its politics. *J R Soc Med*.  
219 2008;101(12):572-573. doi:10.1258/jrsm.2008.08k036
- 220 4. Lowcock EC, Rosella LC, Foisy J, McGeer A, Crowcroft N. The social determinants of  
221 health and pandemic H1N1 2009 influenza severity. *Am J Public Health*. 2012;102(8):51-  
222 58. doi:10.2105/AJPH.2012.300814
- 223 5. Slusser M. The logic in ecological: I. The logic of analysis. *Am J Public Health*.  
224 1994;84(5):825-829. doi:doi/10.2105/AJPH.84.5.825
- 225 6. Texier G, Farouh M, Pellegrin L, et al. Outbreak definition by change point analysis: A tool  
226 for public health decision? *BMC Med Inform Decis Mak*. 2016;16(1):1-12.  
227 doi:10.1186/s12911-016-0271-x
- 228 7. Mitjà O, Clotet B. Use of antiviral drugs to reduce COVID-19 transmission. *Lancet Glob*  
229 *Heal*. 2020;(20):1-2. doi:10.1016/S2214-109X(20)30114-5
- 230 8. Institutional Profiles Database (IPD). DG Trésor.  
231 <http://www.cepii.fr/institutions/EN/ipd.asp>. Published 2016. Accessed March 19, 2020.
- 232 9. Madhav N, Oppenheim B, Gallivan M, Mulembakani P, Rubin E, Wolfe N. Pandemics:  
233 Risks, impacts, and mitigation. In: Jamison DT, Gelband H, Horton S, et al., eds. *Disease*  
234 *Control Priorities: Improving Health and Reducing Poverty (Volume 9)*. 3rd ed.  
235 Washington, DC: World Bank Group; 2017:315-345.
- 236 10. Imports of Goods and Services (Current US\$). The World Bank.  
237 <https://data.worldbank.org/indicator/NE.IMP.GNFS.CD>. Published 2017. Accessed March  
238 19, 2020.
- 239 11. Population Density (People per sq. km of Land Area). The World Bank.  
240 <https://data.worldbank.org/indicator/EN.POP.DNST>. Published 2018. Accessed March 19,  
241 2020.



- 242 12. Irvin RA, Stansbury J. Citizen Participation in Decision Making: Is It Worth the effort?  
243 *Public Adm Rev.* 2004;64(1):55-65. doi:10.1111/j.1540-6210.2004.00346.x
- 244 13. Beierle TC, Konisky DM. What are we gaining from stakeholder involvement?  
245 Observations from environmental planning in the Great Lakes. *Environ Plan C Gov Policy.*  
246 2001;19(4):515-527. doi:10.1068/c5s
- 247 14. Santiso C. IMPROVING FISCAL GOVERNANCE AND CURBING CORRUPTION :  
248 HOW RELEVANT ARE AUTONOMOUS AUDIT AGENCIES ? 2006;7(2):97-108.
- 249 15. Primary Completion Rate, Total (% of Relevant Age Group). The World Bank.  
250 <https://data.worldbank.org/indicator/SE.PRM.CMPT.ZS>. Published 2018. Accessed March  
251 19, 2020.
- 252 16. Sorveglianza Integrata COVID-19 in Italia. Ordinanza n. 640, 21 Mar 2020. Istituto  
253 Superiore di Sanità.  
254 [https://www.epicentro.iss.it/coronavirus/bollettino/Infografica\\_21marzo ITA.pdf](https://www.epicentro.iss.it/coronavirus/bollettino/Infografica_21marzo_ITA.pdf).  
255 Published 2020. Accessed March 22, 2020.
- 256 17. Country Comparison: Median Age. CIA World Factbook.  
257 [https://www.cia.gov/library/publications/the-world-factbook/fields/rawdata\\_343.txt](https://www.cia.gov/library/publications/the-world-factbook/fields/rawdata_343.txt).  
258 Published 2020. Accessed March 19, 2020.
- 259 18. Hofstede G. *Culture's Consequences: Comparing Values, Behaviors, Institutions, and*  
260 *Organizations across Nations*. 2nd ed. Thousand Oaks, CA: Sage; 2001.
- 261 19. Fincher CL, Thornhill R, Murray DR, Schaller M. Pathogen prevalence predicts human  
262 cross-cultural variability in individualism/collectivism. *Proc R Soc B Biol Sci.*  
263 2008;275(1640):1279-1285. doi:10.1098/rspb.2008.0094
- 264 20. Borg MA, Camilleri L, Waisfisz B. Understanding the epidemiology of MRSA in Europe:  
265 Do we need to think outside the box? *J Hosp Infect.* 2012;81(4):251-256.  
266 doi:10.1016/j.jhin.2012.05.001
- 267 21. Mulki JP, Caemmerer B, Heggde GS. Leadership style, salesperson's work effort and job  
268 performance: The influence of power distance. *J Pers Sell Sales Manag.* 2015;35(1):3-22.  
269 doi:10.1080/08853134.2014.958157
- 270 22. Winterich KP, Zhang Y. Accepting Inequality Deters Responsibility: How Power Distance  
271 Decreases Charitable Behavior. *J Consum Res.* 2014;41(2):274-293. doi:10.1086/675927
- 272 23. P. Vatcheva K, Lee M. Multicollinearity in Regression Analyses Conducted in

- 273 Epidemiologic Studies. *Epidemiology*. 2016;06(2):1-9. doi:10.4172/2161-1165.1000227
- 274 24. Frank KA. Impact of a confounding variable on a regression coefficient. *Sociol Methods*  
275 *Res*. 2000;29(2):147-194. doi:10.1177/0049124100029002001
- 276 25. Frank KA, Maroulis SJ, Duong MQ, Kelcey BM. What would it take to change an  
277 inference? Using Rubin's causal model to interpret the robustness of causal inferences. *Educ*  
278 *Eval Policy Anal*. 2013;35(4):437-460. doi:10.3102/0162373713493129
- 279 26. Solomon T, Lewthwaite P, Perera D, Cardoso MJ, McMinn P, Ooi MH. Virology,  
280 epidemiology, pathogenesis, and control of enterovirus 71. *Lancet Infect Dis*.  
281 2010;10(11):778-790. doi:10.1016/S1473-3099(10)70194-8
- 282 27. Joshi H, Lenhart S, Albright K, Gipson K. Modeling the effect of information campaigns  
283 on the HIV epidemic in Uganda. *Math Biosci Eng*. 2008;5(4):757-770.  
284 doi:10.3934/mbe.2008.5.757
- 285 28. Ferguson JK. Preventing healthcare-associated infection: risks, healthcare systems and  
286 behaviour. *Intern Med J*. 2009;39(9):574-581. doi:10.1111/j.1445-5994.2009.02004.x
- 287 29. Bao Y, Sun Y, Meng S, Shi J, Lu L. 2019-nCoV epidemic: address mental health care to  
288 empower society. *Lancet*. 2020;395(10224):e37-e38. doi:10.1016/S0140-6736(20)30309-3  
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Cross-National Variation in COVID-19 Outbreaks

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Country	GROWTH	POLINS	DISCOV	IMPORT	DENSITY	PARPOP	FREEINF	CORRUP	EDUCAT	AGEMED	INDLSM	POWDIS	INDULG
Qatar	0.325		4.111	62.193	5.479	0.667	3.000	3.000	4.434	33.7	38	80	34.000
Romania	0.266	3.000	4.060	92.287	4.438	2.000	4.000	0.250	4.540	42.5	30	90	19.866
Russia	0.084	2.500	3.466	326.913	2.177	2.333	2.500	1.500	4.556	40.3	39	93	19.866
Saudi Arabia	0.331		4.143	202.046	2.752	1.333	3.000	2.000	4.632	30.8	38	80	34.000
Senegal	0.208	4.000	4.143	7.505	4.411	2.000	3.500	2.250	3.843	19.4	20	77	78.000
Serbia	0.405	2.500	4.205	25.207	4.380	2.000	4.000	0.750	4.604	43.4	25	86	28.125
Singapore	0.069	3.500	3.178	495.467	8.981	3.000	3.000	4.000	4.600	35.6	20	74	45.536
Slovakia	0.342	4.000	4.205	88.496	4.730	3.333	4.000	1.000	4.567	41.8			
Slovenia	0.329	4.000	4.174	35.996	4.631	2.667	4.000	2.500	4.575	44.9	27	71	47.545
South Africa	0.363	3.750	4.190	99.085	3.863	3.333	4.000	1.500	4.453	28.0	65	49	
South Korea	0.173	4.000	2.996	576.913	6.272	3.333	4.000	3.500	4.620	43.2	18	60	29.464
Spain	0.227	3.750	3.466	413.731	4.538	2.667	4.000	0.750	4.607	43.9	51	57	43.527
Sri Lanka	0.049	2.250	3.332	25.403	5.845	2.333	3.000	1.000	4.574	33.7			
Sweden	0.180	4.000	3.466	222.841	3.219	4.000	4.000	3.750	4.603	41.1	71	31	77.679
Switzerland	0.330	4.000	4.043	370.406	5.373	4.000	4.000	2.750	4.347	42.7	68	34	66.071
Taiwan	0.059	3.750	3.045		4.000	4.000	2.250		4.23	42.3	17	58	49.107
Thailand	0.063		2.565	247.430	4.912	2.333	4.000	1.500	4.459	39.0	20	64	45.089
Togo	0.055	2.000	4.205	2.103	4.977	1.667	4.000	1.000	4.063	20.0			
Tunisia	0.259	3.000	4.143	22.671	4.310	3.000	3.500	0.750	4.437	32.7	38	80	34.000
Turkey	0.790	2.500	4.277	249.702	4.672	1.667	2.500	1.250	4.572	32.2	37	66	49.107
Ukraine	0.210	2.500	4.159	62.494	4.344	3.333	3.000	1.250	4.599	41.2			
United Arab Emirates	0.076		3.296	290.783	4.910	0.333	3.000	2.500	4.449	38.4	38	80	34.000
United Kingdom	0.150	4.000	3.434	841.969	5.616	4.000	4.000	4.000	4.615	40.6	89	35	69.420
United States	0.138	3.750	3.045	2932.062	3.577	4.000	4.000	4.000	4.593	38.5	91	40	68.080
Vietnam	0.052	2.000	3.178	221.075	5.731	2.333	3.000	0.250	4.629	31.9	20	70	35.491

GROWTH: Outbreak's relative growth rate; POLINS: Functioning of political institutions (0 = widespread irregularities to 4 = perfectly fair); DISCOV: Time gap till discovery of first case, logged; IMPORT: Import volume (2017, in bn USD); DENSITY: Population density (2018), logged; PARPOP: Participation in political institutions (0 = very low to 4 = strong participation); FREEINF: Access to foreign information (0 = no to 4 = total freedom); CORRUP: Corruption (0 = high to 4 = very low level); EDUCAT: Performance of education system (average of years 2000 to 2018), logged; AGEMED: Median age; INDLSM: Individualism (0 = strongly collectivistic to 100 = strongly individualistic); POWDIS: Power distance (0 = low to 100 = high); INDULG: Indulgence (0 = typically restraint to 100 = typically indulgent).

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293 **Table 2: Regression results**

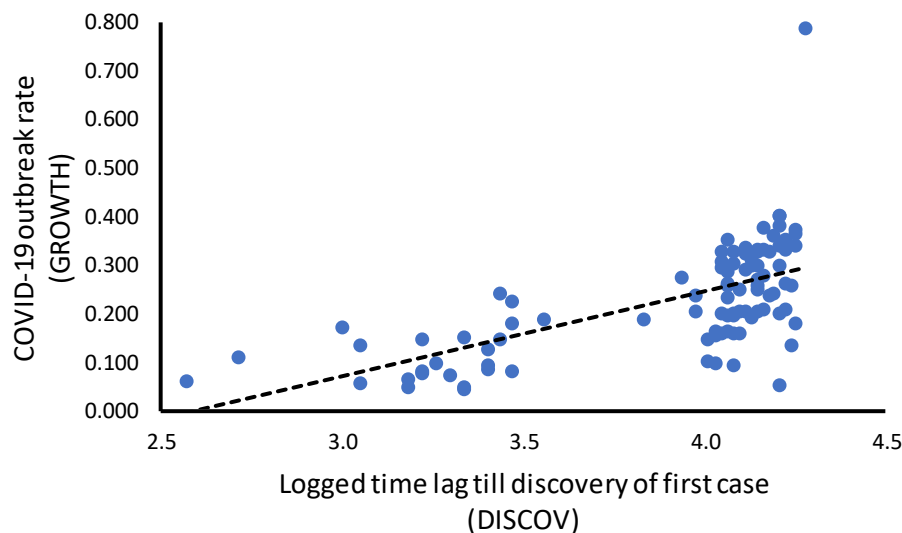
	beta	Beta	Std. err.	t	p	VIF	Confound threshold	Impact threshold
Constant	-1.153583		0.132025	-8.738	5.57E-12			
POLINS	0.121066	1.098561	0.011473	10.552	7.86E-15	3.999	81.151	0.696
DISCOV	0.247635	1.167458	0.017465	14.179	5.15E-20	2.502	85.972	0.801
IMPORT	0.000166	0.528302	0.000025	6.510	2.39E-08	2.430	70.046	0.482
DENSITY	-0.007607	-0.095227	0.004624	-1.645	0.105634	1.236	17.288	0.030
PARPOP	-0.061203	-0.552946	0.009286	-6.591	1.76E-08	2.597	69.823	0.479
FREEINF	-0.070824	-0.569313	0.010113	-7.003	3.73E-09	2.438	71.600	0.508
CORRUP	-0.062390	-0.647649	0.009035	-6.905	5.39E-09	3.246	71.197	0.501
EDUCAT	0.110094	0.333678	0.025384	4.337	0.000062	2.184	54.141	0.279
AGEMED	0.005623	0.460424	0.001188	4.731	0.000016	3.495	57.978	0.318
INDLSM	-0.001668	-0.319459	0.000451	-3.696	0.000507	2.757	46.222	0.210
POWDIS	-0.001911	-0.326253	0.000472	-4.052	0.000161	2.392	50.874	0.248
INDULG	0.001203	0.230221	0.000349	3.450	0.001084	1.643	42.299	0.181

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295 POLINS: Functioning of political institutions (0 = widespread irregularities to 4 = perfectly fair); DISCOV: Time gap till discovery of first case, logged; IMPORT: Import  
 296 volume (2017, in bn USD); DENSITY: Population density (2018), logged; PARPOP: Participation in political institutions (0 = very low to 4 = strong participation); FREEINF:  
 297 Access to foreign information (0 = no to 4 = total freedom); CORRUP: Corruption (0 = high to 4 = very low level); EDUCAT: Performance of education system (average  
 298 of years 2000 to 2018), logged; AGEMED: Median age; INDLSM: Individualism (0 = strongly collectivistic to 100 = strongly individualistic); POWDIS: Power distance (0  
 299 = low to 100 = high); INDULG: Indulgence (0 = typically restraint to 100 = typically indulgent).

300

301 **Figure 1: Association between time lag of COVID-19 outbreak and growth rate**



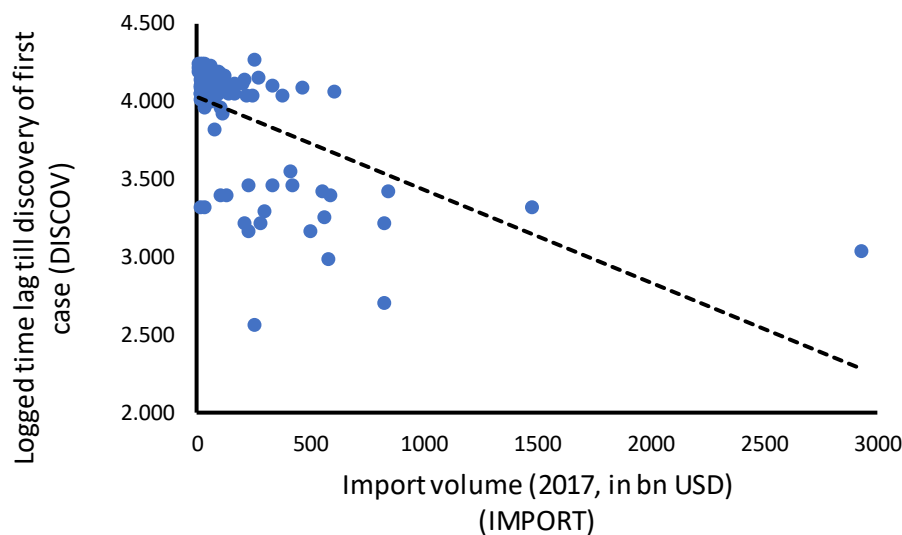
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306 **Figure 2: Association between import volume and time lag of COVID-19 outbreak**



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