The Economic and Institutional Determinants of COVID-19 Mortality

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ABSTRACT

This paper examines the potential influence of economic and institutional factors on the death toll of the novel coronavirus pandemic. In this endeavour, we estimate a variety of functions using the Poisson Pseudo-Maximum Likelihood method (PPML) with cross-sectional data from 107 countries. Economic factors are represented alternatively through GDP per capita and unemployment, while the multiple aspects of institutional quality are encompassed through different indices. Our results suggest that economic variables do not directly affect the death rates of COVID-19 while institutional variables such as regulatory quality, government effectiveness and corruption control have a significant and consistent downward correlation with COVID-19 mortality across countries. These results support the claim that investing in better institutions helps mitigate the deadliness of infectious diseases.

JEL: C21; I18

Keywords: economy; quality of institutions; COVID-19 mortality

I. INTRODUCTION

As the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection (COVID-19) pandemic continues to spread and cause the death of hundreds of thousands of people, the research community's interest itself is expanding to the various dimensions of this new global health challenge. In this context, medical research studies are attempting to scrutinise the properties of the novel coronavirus and explore the possibilities of an effective vaccine.

While some are critical regarding the preparedness of both developed and developing countries to face such a rapidly contagious, or the lack thereof, most economic papers discuss the very impact of COVID-19 on various variables, *e.g.* GDP, consumption and financial markets. Here, the emphasis is put on simulating the impact of COVID-19 on said variables and its potential evolution in the short and medium terms [Atkeson (2020), McKibbin and Fernando (2020), Eichenbaum *et al*. (2020)]. Other authors cover the effects of previous epidemics in order to extrapolate their lessons, in an attempt to improve visibility for policy makers while bypassing the lack of data on the ongoing SARS-CoV-2 outbreak [Barro *et al*. (2020)].

The novelty of our paper comes from reversing the causality direction and shedding light on the potential influence of economic and institutional variables on the COVID-19 mortality rates. We hypothesize that those variables could influence a country's preparedness when coming up against a disease outbreak, and by extension, its ability to mitigate its death toll. So far, the existing literature on the effect of institutions and the economy on mortality is limited to natural disasters, such as hurricanes and earthquakes [Kahn (2005), Toya and Skidmore (2007), Raschky (2008)].

We assess the effect on COVID-19 mortality using a cross-section model with data from 107 countries. In this process, we use the Poisson Pseudo-Maximum Likelihood methodology (PPML), in order to avoid the loss of the 'zero' observations due to log-linearization and to remove heteroscedasticity. For robustness check, we alternatively use GDP per capita and unemployment as the economic variable, and four different indices covering different aspects of institutional quality. The model also encompasses an estimation of the impact of education, and various control variables.

The main results suggest that the economic variables have had no influence on the lethality of the novel coronavirus disease, whether we use GDP per capita or unemployment rates. On the other hand, the effect of the institutional variables on mortality rates is shown to be significant and consistently downward. This suggests that economic variables are not necessarily a determinant of a country's preparedness and capacity to mitigate outbreak deaths, and that the quality of institutions is what truly enables countries to save human lives. Another possible explanation would be the potential existence of a non-linear relationship between the economic variables and the COVID-19 mortality rate. The results also shed light on the potential link between health spending and the disease's mortality.

Section II of this paper discusses empirical studies that covered comparable topics. Section III presents the data and methodology used in this paper, while Section IV focuses on the main results. Finally, Section V concludes and discusses the potential limits of the study.

II. LITERATURE REVIEW

The bulk of research papers examine the impact of outbreaks on the economy. Very few, if any, focus on the influence that economic and institutional factors might drive on COVID-19 mortality rates or those of any other diseases. The most recent literature rather focuses on the impact of COVID-19 itself on various variables.

In this perspective, Atkeson (2020) uses an epidemiological SIR model (Susceptible-Infected-Recovered) to simulate how the COVID-19 pandemic would evolve in the US and to discuss its potential economic repercussions over a period between 12 and 18 months. Here, regardless of the scenario, the author argues that the peak period should be characterized by 10% to 20% of the population being infected simultaneously, which would result in severe staffing shortages for key financial and economic infrastructure. The classic SIR model is also used by Eichenbaum *et al.* (2020) to study how economic decisions change due to an outbreak, but as an additional component of an otherwise canonical General Equilibrium model. In this model, consumers change their level of consumption following the infection rate and to whether they are susceptible, infected, or recovered. The model's outcome suggests an inevitable trade-off between the severity of the recession and the health consequences of the epidemic: the optimal containment policy increases the severity of the recession but saves a substantial amount of lives.

The SIR model is not used by all recent papers. For instance, McKibbin and Fernando (2020) motivate a G-Cubed multi-country model with 6 sectors and 24 countries, i.e. a hybrid of DSGE and CGE models. They convert different shocks generated by the COVID-19 pandemic into economic shocks that affect labour supply, the costs of doing business, equity risk and country risk. The results are a sharp decline in global GDP as well as in consumption and investment –which causes a drop in equity markets. Comparable results are found by Keogh-Brown *et al.* (2010), who use a quarterly macroeconomic model for the UK. However, the latter paper emphasises that once the outbreak is over, the economy should return to approximately where it would have been if there had not been any epidemic, and that the real economic danger occurs when policy and behavioural change in response to the pandemic occur, as prolonged school closures might cause a sharper supply-side shock for instance. This behavioural component is also predominant in Ramelli and Wagner (2020) who examine how the anticipated real effects from the COVID-19 pandemic were amplified via financial channels. They assess the influence of trade disruptions, the evolution of firm values –by including the role of cash and leverage, and how managers and analysts discussed COVID-19 throughout the health crisis.

Another stream of papers covered the influence of previous infectious outbreaks, which could help lessen uncertainty regarding the potential impact of the current pandemic. Barro *et al.* (2020) explore data from the 1918-1920 'Spanish flu' with the aim to extrapolate the potential impact of the COVID-19 pandemic. Using a 48-country panel least squares estimation, they find that the early 19th century pandemic had a downward influence on GDP (-6%) and consumption (-8%), while the death toll reached 2.1% of world population. Hai *et al.* (2004) use more recent survey data on the economic repercussions of SARS in China, and argue that GDP would lose a 1-2 percentage point, with tourism being hit the hardest. The latter fact is arguably applicable to the novel coronavirus pandemic.

However, a few previous studies did cover the institutional and economic underpinnings of natural disaster death tolls. The latter are worth discussing considering their similarities with outbreaks. In this framework, Toya and Skidmore (2007) claim that more developed countries face fewer deaths from natural disasters and less economic damages. Using OLS, the paper's main contribution is demonstrating that income is not the only important determinant of the extent of disaster deaths and economic damages. The role of educational attainment, trade openness, financial sector development and government size turns out significant as well.

Other studies also cover further determinants of disaster mortality. Using disaster-related annual deaths statistics in 73 countries from 1980 to 2002, Kahn (2005) finds that countries that are more democratic suffer less death during natural disasters, notwithstanding their frequency. The author also finds a negative correlation between a country's income level and its human casualties. He uses both OLS and instrumental variables and controls for the disasters frequency. Moreover, Kahn (*ibid*.) reveals that geography plays a determinant role as well, with elevation having a downward influence on death counts, while distance from the equator raises disaster casualties.

These results are corroborated by Raschky (2008), whose cross-section model suggests that better institutions insulate against human and economic losses from natural disasters. However, unlike Kahn (2005) who focuses mainly on democracy, Raschky (2008) uses two other institutional variables from 1984 to 2004, i.e. governmental stability and investment climate. Escaleras *et al*. (2007) focus on the relationship between public sector corruption and fatalities from earthquakes. The paper analyses 344 major quakes from 42 countries between 1975 and 2003. Across various specifications, the results suggest that a country's level of public sector corruption is positively and significantly correlated with the fatalities caused by large quakes regardless of the corruption index used, the control variables included, or the estimation strategy employed.

Elements of discussion as regards to the relationship between institutions and preparedness can be found in Cohen and Werker (2008), who argue that governments tend to underinvest in disaster prevention when they expect that they are likely to receive aid in the event of dire circumstances, in what is defined as the racket effect. This incentive is higher in countries with lower quality institutions, where embezzlement is usually more likely. Using a micro-founded *Political Model of Disasters*, the authors suggest that during disasters, 'rapacious governments' have a stronger ability to increase their level of theft, considering that this becomes tolerated by donors in the sake of delivering urgently needed aid[1].

[1] Cohen and Werker (2008), P. 797

III- DATA AND METHODOLOGY

In order to analyse properly the relationship between a country's economic and institutional factors and COVID-19 mortality, we use a model that includes the variables of interest, along with a various range of control variables. The variable choice, the model's specifications and the data are detailed below.

The Data

Initially, we collect yearly time-series data from different sources (shown below in parentheses) and for a wide set of countries regarding the following economic and institutional indicators:

- GDP per capita (World Bank and OECD National Accounts data);
- Unemployment Rate (International Labour Organisation database);
- Current Health Expenditure (Global Health Expenditure database of the WHO);
- Corruption Perceptions Index, CPI (Transparency International);
- Learning-adjusted Average Number of Years in School (World Bank database);
- Government Effectiveness (Worldwide Governance Indicators);
- Voice and Accountability (Worldwide Governance Indicators);
- Regulatory Quality (Worldwide Governance Indicators).

The CPI score is a composite indicator that measures public sector corruption levels as perceived by experts and business executives. It draws data from a combination of 13 surveys and assessments of corruption in different countries, collected by a variety of reputable institutions[2]. Data for the variables Government Effectiveness, Voice/Accountability and Regulatory Quality are collected from the Worldwide Governance Indicators database, which contains composite governance indicators based on over 30 underlying data sources[3]. As for the learning-adjusted average years of schooling, it is an indicator that, together with the quantity of schooling (in terms of years), also considers its quality in terms of learning outcomes. This variable should provide insights on the potential influence of the population's level of education on COVID-19 damage.

Not all of the indicators above are available for every country; therefore, after screening the data, we are left with observations for the 107 countries listed in **TABLE 1**. For the cross-section, we chose the data from 2017, with a twofold rationale. Firstly, it is the most recent year with complete data for our set of 107 countries. Secondly, we deem the three-year margin could be a relatively sufficient period when considering the gradual influence of economic and institutional variables on a country's preparedness to face disasters or disease outbreaks. Furthermore, most institutional variables represent a structural element of a society, and changes occur rather slowly. Ergo, we argue that if the correlation between COVID-19 mortality and the institutional variables we chose holds, it most likely does with a time lag.

Data on COVID-19 are collected from the *European Centre for Disease Prevention and Control*. Since the dataset provides daily cases, deaths and recoveries, we compute the cumulative cases and deaths after 60 days from the first case of Coronavirus infection for each country. In this way, we can obtain some degree of homogeneity across countries in terms of exposure to the virus. Considering that it is still an ongoing pandemic at the time of our study, the available data is still

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[2] Transparency International (2017), PP. 1-4
[3] Kaufmann *et al*. (2010), PP. 5-8

limited, although a 60-day period proves to be more than sufficient to analyse the differences in response to the pandemic across countries. Moreover, considering the first 60 days of contagion allows us to focus on a period in which countries were bound to rely almost exclusively on their own means, as approximated via their economic and institutional variables. Hypothetically, beyond a given period the countries' real capacities to respond to the outbreak might become biased by externalities, such as international aid, learning and copying successful policies, etc. This hypothesis could be tested by repeating the present study once the pandemic ends.

Table 1: list of the examined countries [by income group]

[Low-income]	[Lower-mid income]	[Upper-mid income]	[High-income]	
Benin	Bangladesh	Algeria	Argentina	Latvia
Burkina Faso	Cambodia	Armenia	Australia	Lithuania
Chad	Cameroon	Azerbaijan	Austria	Luxembourg
Ethiopia	Egypt, Arab Rep.	Bosnia and Herzegovina	Bahrain	Malta
Guinea	El Salvador	Brazil	Belgium	Netherlands
Haiti	Georgia	Bulgaria	Canada	New Zealand
Liberia	Ghana	China	Chile	Norway
Niger	Honduras	Colombia	Croatia	Oman
Tanzania	India	Costa Rica	Cyprus	Panama
Togo	Indonesia	Dominican Republic	Czech Republic	Poland
Zimbabwe	Kenya	Ecuador	Denmark	Portugal
	Kyrgyz Republic	Gabon	Estonia	Saudi Arabia
	Mauritania	Guatemala	Finland	Singapore
	Moldova	Guyana	France	Slovak Republic
	Morocco	Iran, Islamic Rep.	Germany	Slovenia
	Nicaragua	Iraq	Greece	Spain
	Nigeria	Jamaica	Hungary	Sweden
	Pakistan	Jordan	Iceland	Switzerland
	Philippines	Kazakhstan	Ireland	United Arab Emirates
	Sri Lanka	Lebanon	Israel	United Kingdom
	Sudan	Malaysia	Italy	United States
	Tunisia	Mexico	Japan	Uruguay
	Ukraine	Paraguay		
		Peru		
		Romania		
		Serbia		
		South Africa		
		Thailand		
		Turkey		

Using cumulative cases and deaths statistics, we compute the mortality ratio for each country. Coronavirus-infection data come with a caveat, *i.e.* the heterogeneity in terms of the criteria and methods used by different countries (or even different regions in the same country) to collect such data. The testing is handled very differently across countries in terms of scope and criteria used to select the individuals to test for COVID-19. There are divergences in how deaths are counted as well, since the cause of death cannot always be clearly attributed to the coronavirus. For instance, some Italian regions have been accused of inflating their death count by considering also people who died from other causes than COVID-19.

Furthermore, several countries have encountered difficulties in securing and delivering proper testing, which has allegedly influenced the number of infected people and the spread of the virus [Cheng *et al*. (2020)]. This problem is more serious in developing countries [Giri and Rana (2020)]. The discrepancies in terms of testing have also a substantial influence on the recorded cases, as a large number of patients show mild or no symptoms, or seem to suffer from comorbidities that are not related to COVID-19. For example, the number of tests for each registered COVID-19 case reaches 56.97 and 53.6 in Germany and the UK, respectively. The ratio is at around 36.17 in Italy, while it is merely 2.23 in Bolivia and 1.3 in Egypt. The latter country shows discrepancy even when compared with countries from its same region (Middle East and North Africa) and income group, such as Morocco, which has a 20.74 ratio[4]. A low ratio could insinuate that the numbers of cases and deaths are both higher than the officially registered ones.

In the absence of a consistent standard for data collection and reporting, and considering the discrepancies in terms of testing policies, the quantitative results should evidently be considered with caution. However, since we use the registered deaths as a share of the registered cases, this margin of risk is reduced and the data can still provide significant insights on whether or not certain relationships hold.

The Empirical Methodology

First, we construct a baseline cross-section model in which the death rate of COVID-19 is explained by GDP per capita, Current Health Expenditure and an institutional variable:

$$mortality_i = \beta_1 y_i + \beta_2 inst_i + \beta_3 health_i + D_i\delta + \varepsilon_i$$

where $mortality_i$ represents COVID-19 deaths as a proportion of the total number of cases in each country; y_i is GDP per capita; $health_i$ stands for current health expenditure and $inst_i$ is the variable that approximates the quality of institutions. For the latter, we opt for a different indicator for each model specification, i.e. the CPI score, government effectiveness, regulatory quality, voice and accountability, and the adjusted average number of years in school. This approach aims to verify the robustness of any correlations the model would yield on the institutional front.

We introduce dummy variables in the regression as well, summarised by D_i. Together with regional dummies that control for potential geographical factors, we introduce an epidemiological

[4] Authors' calculations based on the Worldometer's data available up to 02 October 2020.

dummy variable that assumes the value of '1' if a country reached the community transmission, namely "when territories experience large numbers of cases not linkable to transmission chains and/or multiple unrelated clusters in several areas of said territory", and '0' otherwise[5].

In order to ascertain the robustness of the economic influence on the mortality of COVID-19, or absence thereof, this paper also takes into consideration unemployment as an alternative economic explanatory variable. Given the possible multicollinearity issue that might arise from having both per capita GDP and unemployment rate in the same equation, we rather substitute the latter to the former as indicated in the following specification:

$$mortality_i = \beta_1 u_i + \beta_2 inst_i + \beta_3 health_i + D_i\delta + \varepsilon_i$$

where u_i is the unemployment rate.

The introduction of the different proxy variables under $inst_i$ gives us a wider view of different social and institutional factors that can influence the death rate of an infectious disease outbreak, such as corruption, which as Escaleras *et al.* (2007) suggest, influences the responsiveness of governments in other emergency scenarios like natural disasters. It is worth mentioning that, in our model, reverse causality does not represent an issue since the values of all the explanatory variables precede those of COVID-19 data.

Following Santos-Silva and Tenreyro (2006), we opt for the Pseudo-Poisson Maximum Likelihood (PPML) methodology to avoid having heteroscedasticity affect the efficiency of the estimators, as it would if the estimations were OLS-based. PPML should also enable us to avoid losing the zero-observations and the significant explanatory power they hold in our study, *e.g.* the case of countries with no deaths within the 60-day period. Moreover, as Santos-Silva and Tenreyro (*ibid.*) show, the log-linearization of a model in the presence of heteroscedasticity leads to inconsistent estimates as an implication of Jensen's inequality.

The results of the analysis are discussed in the following section.

[5] WHO Coronavirus disease 2019 situation reports

IV- EMPIRICAL RESULTS

Pursuant to the discussion on data, the model's specification and robustness, we turn to PPML results. **TABLE 2** reports the results when we use GDP per capita as the economic variable. The difference between **columns (1) to (4)** in **TABLE 2** is linked to the variables used as indicators for the quality of institutions, while **column (5)** encompasses an education variable, *i.e.* the adjusted average number of school years.

Regardless of the model's specification, the GDP per capita coefficient turns out statistically insignificant. The only exception is in **column (4)** with a rather small positive coefficient, statistically accepted at the 10% threshold. In the absence of robustness for this potential relationship, it is not possible to argue that the COVID-19 mortality rate is influenced by the level of income per capita. This observation is corroborated by the results displayed in **TABLE 3** with the unemployment's coefficient being consistently statistically insignificant.

On the other hand, the results show that the institutional variables drive a consistent and significant downward influence on mortality. In **column 1** of **TABLE 2**, we use the Corruption Perception Index (*CPI*) as a proxy for the quality of institutions; its correlation coefficient is at -0.0228. The institutional effect is higher when using alternative indicators such as *government effectiveness* (**column 2**) and *regulatory quality* (**column 4**), with coefficients reaching -0.41 and -0.5 respectively. The coefficient related to *voice and accountability* is however statistically insignificant. The latter is reported to be significantly negative in **TABLE 3** (**column 3**) at the 10% threshold (-0.356) when unemployment is used as the economic variable instead of GDP per capita.

The influence of the other institutional variables remains quite robust, with relatively similar coefficients in **TABLE 3** for CPI, government effectiveness and regulatory quality, respectively at -0.0179, -0.362 and -0.453.

Here, the mixed *voice and accountability* results could be interpreted as participative democracy not being strictly involved in a country's preparedness to face infectious diseases and mitigate their death ratios. The four other indicators measure institutional aspects that seem to be more directly linked to the effectiveness of governance when managing such crises. Their coefficients clearly signify that the better is the quality of institutions the lower is the COVID-19 mortality risk. This relationship is not influenced by the other variables included in the estimated function.

The coefficient related to current health expenditures is also robust, with positive values ranging from 0.107 to 0.150, all significant at the 1% threshold regardless of the model's specification. In other words, the more a country spends on healthcare the higher is its COVID-19 death rate. This puzzle does have a potential explanation, under the assumption that larger health spending could be responding to a higher need for medical care among the population. Therefore, the GDP proportion of the health budget could be correlated with how relatively large is the proportion of fragile groups among the population of a given country, *e.g.* people with chronic diseases and senior citizens, and the medical costs that come with that. This can be estimated using, as a proxy, the median age of the population. In this frame, we run a regression that includes the geographical dummy variables, and the population's median age turns out to be positively correlated with health expenditure, with a strongly significant +0.0393 coefficient.

TABLE 2: PPML results with GDP per capita (dependent variable: COVID-19 mortality rate)

VARIABLES	(1) CPI	(2) Effective gov.	(3) Democracy	(4) Regulation	(5) Education
GDP per capita	8.75e-06	5.68e-06	8.88e-07	7.44e-06*	-4.02e-06
	(5.73e-06)	(4.21e-06)	(4.51e-06)	(4.25e-06)	(4.15e-06)
Health exp. (% of GDP)	0.150***	0.117***	0.120***	0.107***	0.121***
	(0.0485)	(0.0373)	(0.0427)	(0.0353)	(0.0419)
Stage 3 dum.	0.425**	0.451**	0.416**	0.396*	0.427**
	(0.193)	(0.198)	(0.196)	(0.204)	(0.201)
CPI score	-0.0228**				
	(0.00987)				
Africa dum.	1.511***	0.669**	0.776**	0.640**	1.261***
	(0.264)	(0.292)	(0.370)	(0.304)	(0.290)
Latin dum.	1.231***	0.539*	0.731***	0.674***	1.140***
	(0.379)	(0.287)	(0.276)	(0.256)	(0.399)
Asia dum.	0.507	-0.108	-0.313	-0.110	0.389
	(0.313)	(0.237)	(0.392)	(0.243)	(0.356)
Europe dum.	1.101***	0.475*	0.542*	0.656**	0.998**
	(0.345)	(0.272)	(0.280)	(0.262)	(0.405)
North America dum.	-1.168	-1.454**	-1.518**	-1.168*	-1.006
	(0.791)	(0.728)	(0.768)	(0.698)	(0.743)
Gov. effectiveness		-0.410***			
		(0.121)			
Voice and accountability			-0.324		
			(0.199)		
Regulatory quality				-0.501***	
				(0.161)	
Average schooling years					-0.0573
					(0.0424)
Observations	107	107	107	107	107

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The coefficient linked to the variable *adjusted average years of education* is not significant when using GDP per capita as the economic variable, as illustrated in **TABLE 2**. However, it gains significance at the 10% threshold when unemployment is the economic variable in the model, as shown in **TABLE 3**, with the negative value of -0.0728. This negative correlation implies that the more educated is a population the lower is its COVID-19 death toll. The overall education level could positively affect the population's awareness and reactivity, thereby facilitating the implementation of measures such as social distancing and sanitising. However, the potential effect of education on mortality rate lacks robustness.

TABLE 3: PPML results with unemployment (dependent variable: COVID-19 mortality rate)

VARIABLES	(1) CPI	(2) Effective gov.	(3) Democracy	(4) Regulation	(5) Education
Unemployment	-0.0242	-0.0232	-0.0226	-0.0296	-0.0146
	(0.0190)	(0.0187)	(0.0201)	(0.0196)	(0.0174)
Health exp. (% of GDP)	0.168***	0.139***	0.135***	0.138***	0.118***
	(0.0569)	(0.0426)	(0.0520)	(0.0417)	(0.0420)
Stage 3 dum.	0.424**	0.436**	0.397**	0.387*	0.397*
	(0.190)	(0.201)	(0.195)	(0.208)	(0.214)
CPI score	-0.0179**				
	(0.00770)				
Africa dum.	1.450***	0.761***	0.845**	0.733**	1.455***
	(0.224)	(0.283)	(0.336)	(0.286)	(0.248)
Latin dum.	1.143***	0.598**	0.792***	0.705**	1.367***
	(0.353)	(0.302)	(0.287)	(0.275)	(0.449)
Asia dum.	0.465	-0.0280	-0.273	-0.0156	0.563
	(0.293)	(0.232)	(0.360)	(0.235)	(0.371)
Europe dum.	1.138***	0.630**	0.670**	0.838***	1.184***
	(0.348)	(0.263)	(0.261)	(0.265)	(0.432)
North America dum.	-1.234	-1.456*	-1.542*	-1.198	-0.902
	(0.805)	(0.764)	(0.798)	(0.741)	(0.734)
Gov. effectiveness		-0.362***			
		(0.116)			
Voice and accountability			-0.356*		
			(0.191)		
Regulatory quality				-0.453***	
				(0.160)	
Average schooling years					-0.0728*
					(0.0417)
Observations	107	107	107	107	107

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Throughout the different estimations, the insignificant relationship between economic variables and COVID-19's mortality rates remains robust and consistent, whether we use GDP per capita or unemployment rates. This suggests that economic variables are not necessarily a determinant of a country's preparedness and capacity to mitigate outbreak deaths, and that the quality of institutions is what matters most in this framework. Another possible explanation would be the potential existence of a non-linear relationship between the economic variables and COVID-19 mortality rate. Even though they study different phenomena such as flooding and landslides, Kellemberg *et al.* (2008) find that behavioural changes at the micro level in response to increasing income (such as location choice and extent of costly abatement activity) may lead to a nonlinear relationship between aggregate incomes and disaster damages, where the risks increase with income before they decrease.

V. CONCLUDING REMARKS

The present paper studies how the economy and the institutions of a country can influence its mortality rate relative to the COVID-19 pandemic. We collect cumulative 60-day data on coronavirus cases and deaths, as well as several economic, institutional and social indicators from different sources. Then, we use the Pseudo-Poisson Maximum Likelihood approach to estimate the relationship between the aforementioned factors and COVID-19 death rates, while controlling for the effects of geography and the contagion stage.

We find that per capita GDP and the unemployment rate do not have a direct correlation with COVID-19 mortality, suggesting that economic variables do not necessarily determine the preparedness to face the outbreak of the current pandemic. The quality of institutions, on the other hand, seems to have driven a significant influence on the COVID-19 death toll, as revealed by most of the institutional indicators we utilise in this paper. A negative and consistently significant correlation holds, indeed, between the infectious disease's death rate and the CPI score, government effectiveness and regulatory quality. The latter three could be seen as proxies for different institutional determinants of a country's ability to handle a pandemic with a minimum of human losses.

The influence of other variables, such as voice and accountability and average school years, is less robust across specifications, suggesting that factors like participative democracy and education might not be directly involved in a country's response to the outbreak.

As for the correlation between COVID-19 death rates and current health expenditure, it comes out with a seemingly puzzling positive coefficient. One possible explanation for this finding is that greater health expenditure responds to a higher need for medical care among the population, *ceteris paribus*. Therefore, higher health spending could imply a relatively larger aging and fragile proportion of the population, hence the higher mortality risk when exposed to SARS-CoV-2 infections.

The empirical evidence in this paper shows that institutions have a fundamental role in controlling the deadliness of COVID-19. Ergo, investing in developing better institutions, not only has countless benefits for the society and economy; it also helps mitigate the damages of infectious disease outbreaks.

The analysis presents a few limits. First, the data does not cover the entire pandemic but rather focuses on the first 60 days of the outbreak in each country. Indeed, this period allows focusing on countries' responses when they were bound to rely almost exclusively on their own means, thereby reducing the risk of externality-related biases. However, this choice was also partly forced by the data availability at the time of this analysis. After the pandemic, it could be interesting to run a similar study and test if, for instance, spillovers across countries have actually affected mortality rates.

Another limit of this study, and of all the studies on the COVID-19 pandemic, is the reliability of the data. Many infected individuals are asymptomatic and may not have been covered in the data. Furthermore, the testing capacity was in fact very limited in the early stages of the outbreak, and there are tremendous discrepancies between the different countries in terms of the 'COVID tests/cases' ratio. Thus, in the absence of a consistent standard for data collection and reporting, and considering the discrepancies in terms of testing policies, the quantitative evidence should be considered with caution.

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