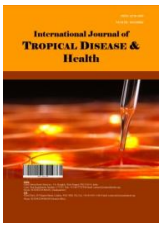

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Governance and the New Corona Virus (COVID-19) Outbreak in the World: Empirical Evidence

Melingui Bate Adalbert Abraham Ghislain[1], Omang Ombolo Messsono[1], Nsoga Nsoga Mermoz Homère[1] and Tsomb Tsomb Etienne Inédit Blaise[2*]

[1]University of Dschang, Cameroon.
[2]University of Yaoundé II, Cameroon.

Authors' contributions

This work was carried out in collaboration among all authors. Author MBAAG carried out the literature review and the introduction. Authors OOM and TTEIB carried out the idea and the empirical tools. Author NNMH managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This paper aims to analyze the effect of public governance on the spread and mortality of the new corona virus. It focuses on the effects of differences observed in government's responsiveness on the spread and mortality of this pandemic around the world.
Sample: Our study is based on a sample of 129 countries from December, 8th 2019 to May 5th, 2020.
Methods: The Ordinary Least Squares method is applied to cross-sectional data. We also proceed by descriptive statistics and scatter analyses to access the effect of public governance on the spread and the mortality of the Covid-19.
Results: The results obtained show that government response time favors the speed of spread,

**Corresponding author: Email: ineditblaise@yahoo.com;*

level of infection, and mortality related to the Covid-19. The results indicate that countries in which governments have reacted early have lower levels of contamination and deaths than those that reacted late. Finally, our results suggest that the stringency of early government measures is a capital factor explaining the spread and mortality of this virus. Our results are robust to regional specificities, which distinguish relatively more resilient developing countries from developed countries with higher levels of contagion and mortality. Then, we recommend for all categories of countries a greater speed and rigour in government responsiveness in the management of pandemic diseases.

Keywords: COVID-19; governance; OLS; spread; pandemic.

1. INTRODUCTION

The new corona virus (COVID-19) pandemic began in China in the city of Wuhan in December 2019. The number of people worldwide who have died as a result of this disease is estimated at two hundred and fifty thousand nine hundred and nine as of May 5, 2020[1]. It has therefore been classified by the World Health Organization (WHO) as a global health emergency (Li et al*.,* 2020). However, there is still no officially recognized treatment protocol or vaccine against the virus causing this pandemic. In this context, public governance is one of the levers favored by the governments of the affected countries to fight against this pandemic. As noted by the OxCGRT (2020), almost all governments have implemented health and non-health measures to contain the evolution of Covid-19. In this regard, several studies show that public governance, through non-pharmaceutical governmental measures*,*has significantly contributed to contain the spread and mortality of COVID-19 [1-3]*.*

The current mapping of coronavirus infection and death levels, coupled with that of the rigour of government measures, reveals paradoxes that call into question the effectiveness of government measures to respond to this pandemic[2]. Indeed, governments in the African and Asian regions responded spontaneously by putting in place restrictive measures as soon as the first cases of Covid-19 infection were detected. In other regions, however, particularly in Europe and the America, governments have observed a fairly long waiting time before taking the first steps to stop the spread of the virus. In Belgium, Germany and the United Kingdom, for example, the first government response measures were taken 30, 48 and 13 days, respectively, after the first cases of coronavirus were discovered in those countries. Several studies have been carried out to explain the propagation factors as well as the socio-economic consequences of this virus. The study of Puhani [4] and Wang et al. [5], for example, shows that temperature-related climatic factors explain the spread of this virus. Zimmermann et al*.* [6] in turn look at the impact of globalization and show that the level of stringency of government measures explains the dynamics of the virus in the world.

In this article, we look at the effect of government response times and the nature of initial response measures on the global spread and mortality of Covid-19. We hypothesize that the delay in government response and the nature of the initial government responses to the covid-19 pandemic explain the differentials in levels of infection and mortality.

To test this hypothesis, we are using a sample of 129 countries and our analyses cover the period from December 8, 2019 to May 5, 2020. The OLS technique is applied to cross-sectional data. The results obtained show that on average, the shorter the response time, the less the country is affected by the pandemic in terms of infection levels and mortality rates. In addition, we show that the nature and level of rigour of the initial government measures explain the speed of spread, the level of infection and the mortality rate of the virus. Our results extend those of Zhang et al. [7] and Fang et al. [2] who have worked on the factors that explain the spread of Covid-19, without explicitly examining the consequences of government reactivity on the spread of this virus.

[1] *This is data from the Coronavirus Resource Center at Johns Hopkins University.*

[2]*The European continent is the most affected even though it has the highest average index of austerity of government measures. On the other hand, the African continent has the highest level of resilience, despite the difficulties in implementing containment measures linked to the living conditions of the populations and the extroverted nature of these economies. On the other hand, the Asian continent has managed to contain the virus with an average level of rigour of government measures (Analyses made by the authors using data from the OxCGRT index).*

The rest of the paper is organized as follows. Section 2 is devoted to a selective review of the literature. Section 3 presents the stylized facts. Section 4 presents the methodological framework. Section 5 presents and discusses the results. Section 6 concludes.

1.1 Propagation Factors of COVID-19: A Selective Review of the Literature

Studies on the Covid-19 pandemic are mainly focused on the factors that explain the differentials in contamination levels and mortality rates between countries, although other studies are looking at the economic and social consequences of this pandemic. Thus, governance, climate and geography are presented as the main factors explaining the speed of spread and level of mortality of this virus in the world [8,5,4,6,1,3,7,2,9].

Firstly, concerning the climate, Tan et al. [8] show that the spread of SARS in 2003 was related to the ambient temperature in the most affected Chinese cities, including Beijing and Guangzhou. The authors find that at low temperatures, the risk of increasing the daily contamination rate is 18.18 times greater than at higher temperatures. In the case of Covid-19, Wang et al. [5] establish a positive correlation between temperature and the speed of the virus spread in a sample of 429 cities worldwide. Similarly, Puhani [4] shows that temperature differentials between France, Germany, Italy, South Korea, Thailand, Malaysia and Japan explain the differences in contamination rates observed in these countries from February 25 to March 7, 2020.

Secondly, Zimmermann et al. [6] using cross-country data show that geographical and economics factors such as trade, foreign direct investment, international treaties, global tourism and student flows, and international capital movements plays a significant role in the spread of pandemics. For example, they find that countries that are more open to globalization are both more exposed and more resilient to the fatality of the COVID-19.

However, public governance is one of the most extensively analyzed aspects of the coronavirus pandemic literature. Indeed, almost all governments in the affected countries have responded, some more rapidly than others, by taking measures to respond to the pandemic. In some countries, these measures have ranged from simple prescriptions for barrier actions to be taken to more stringent measures such as quarantining entire cities, closing schools or compulsory containment and even closing national borders. Several studies analyze the impact of these public governance measures on the spread and mortality of this virus worldwide [1,3,2].

According to Cowling et al. [1], public measures such as quarantine, isolation, restriction of foreign trade and social distancing have significantly contributed to slowing the spread of the coronavirus and influenza "A H1N1" in Hong Kong. They find that after the closure of schools, the rate of contamination fell by 44% and the rate of pediatric hospitalization by 33% in Hong Kong. Lai et al. [3] analyze the effectiveness of preventive measures on the contamination of healthcare workers in the city of Wuhan in China, especially in Tongji hospital. The authors find that the provision of protective equipment such as surgical masks and coveralls, as well as daily disinfection procedures on hospital wards, helped to reduce the infection rate of medical staff. Fang et al. [2] analyze the effect of government measures restricting the mobility of people, notably the closure of the city of Wuhan on January 23, 2020, on the rate of contamination and the speed of spread of the new coronavirus in China. Their results show that if this measure had not been taken early, the infection rate would have been 64.81% higher in the 347 cities outside Hubei province and 52.67% higher in the 16 other Hubei cities outside Wuhan. Then, the authors implicitly shows that the promptness of the response of public authorities through the measures taken to slow or stop the spread of the virus is an important factor in understanding the dynamics of this pandemic.

In addition to the above-mentioned propagation factors, other aspects are also taken into account in empirical analyses, such as the age structure of the population, latitude, democracy and the ideology of governments [6]. The present study is a continuation of this work and focuses on the responsiveness of governments and the level of rigour of the initial measures taken by states on the spread and mortality of the Covid-19 pandemic around the world.

1.2 Governance and the COVID-19 Spread Around the World: Some Stylized Facts

The influence of public governance measures on the evolution of covid-19 is analyzed in recent

literature. Several works show that governance through non-pharmaceutical measures is the main factor explaining the spread of the virus worldwide [1,10-12]. However, the responsiveness of governments varies widely between countries. To prevent the spread of this pandemic, some countries have responded promptly before or immediately after the first cases of coronavirus infection were confirmed. In other countries, however, Governments have experienced a relatively long response time before taking the first steps to respond to the pandemic. These disparities correlate with the rate of spread, the level of infection and the mortality rate of COVID-19.

Fig. 1 below shows the correlation between the responsiveness of governments and the level of contamination. The speed of spread of the virus corresponds to the time (in days) between the appearance of the disease in China and the first case of infection in each country multiplied by the rate of infection within the concerned country [6]. The slope of this figure indicates a positive relationship between government response time and the speed of virus circulation.

Indeed, countries that anticipated the management of the Covid-19 pandemic by taking response measures before or shortly after the detection of the virus on their territory have a lower rate of spread than those that reacted late. This positive correlation is also observed for the number of deaths Fig. 2. Indeed, countries with a high response time also have higher mortality rates than countries that responded more rapidly to the pandemic.

Paradoxically to Figs. 1 and 2, Fig. 3 shows a positive relationship between the level of stringency of government action and the level of Covid-19 contamination. This shows that countries with a high average level of stringency of initial response measures also have the highest contamination rates.

For example, countries such as France, Italy and Spain with percentage indices of severity of 76; 71 and 88, respectively, each recorded 131863, 211938 and 219329 cases of Covid-19 contamination and 25201, 29079, 25613 cases of deaths. We note that the level of government rigour is positively correlated with the contamination rates of this epidemic. Indeed, this counter-intuitive correlation indicates to some extent that the extent of the measures taken is not sufficient to explain or better understand the impact of public governance in the management of the coronavirus pandemic. This article analyses the effect of government responsiveness on the spread and mortality of this pandemic.

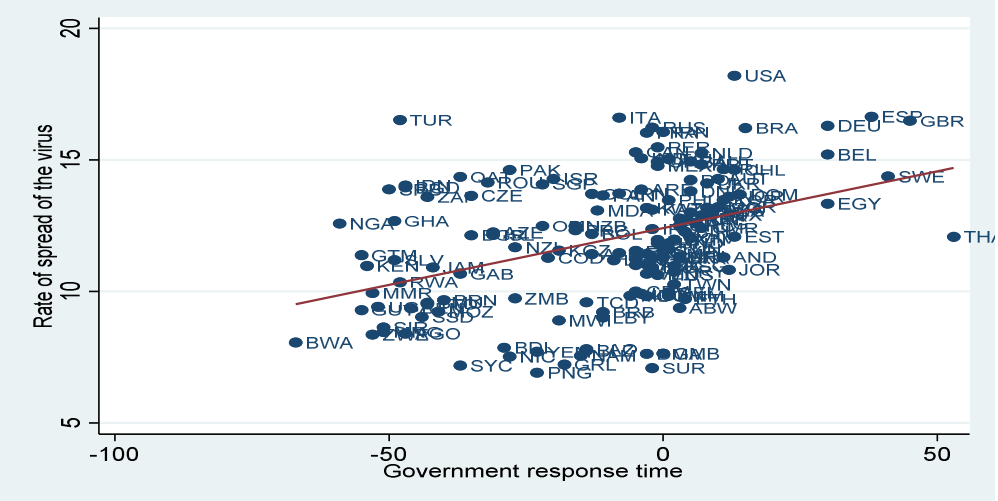

Fig. 1. Government response time and speed of the propagationof the COVID-19

Source: The authors

Note: On the x-axis, negative values correspond to a faster government response and positive values correspond to a later response. This variable is calculated as the difference (in number of days) between the date of detection of the first official case of Covid-19 infection and the date of the first government response

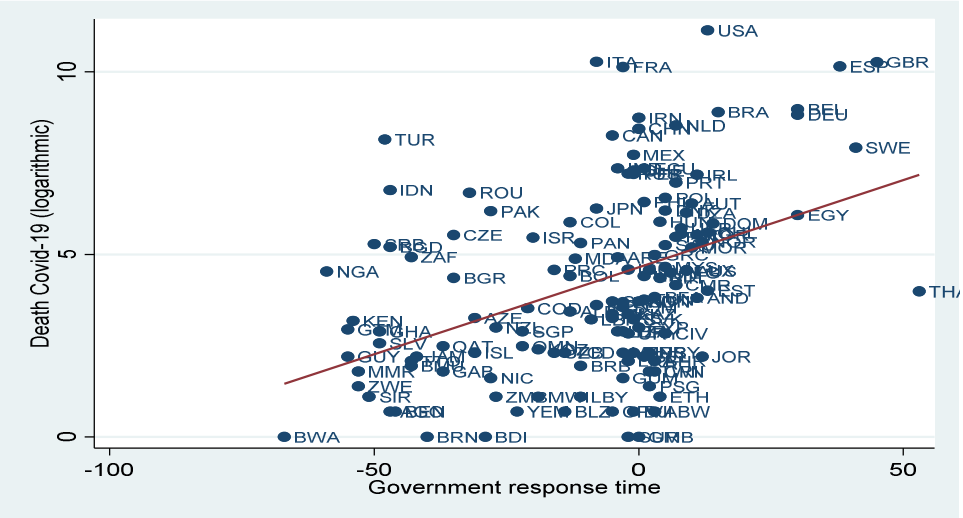

Fig. 2. Government's response time and mortality of the COVID-19

Source: The authors

Note: On the x-axis, negative values correspond to an anticipated government response (before detection of the first case) and positive values correspond to a delayed response (after detection of the first case). Y-axis mortality is the number of deaths in logarithm

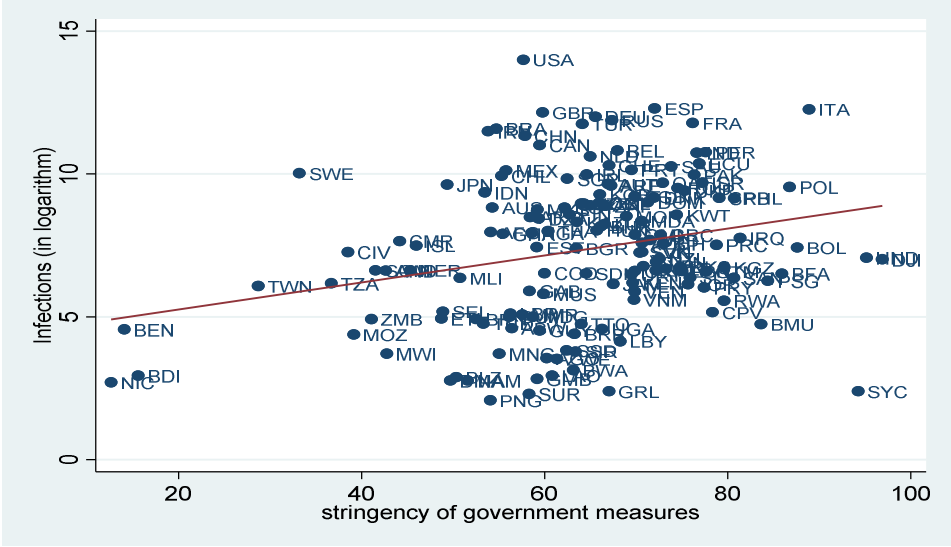

Fig. 3. Rigour of initial government actions and contamination of the COVID-19

Source: The authors

Note: The index of stringency of government measures is calculated by the OxCGRT index database. It ranges from 0 (softer measures) to 100 (more stringent measures)

2. METHODOLOGY

In this section, we discuss the methodological approach used to analyze the effect of public governance on the spread of the virus and mortality. First, we present the variables and data sources. Second, we present the econometric model used.

2.1 Variables and Data Sources

The study covers 129 countries in five regions, including Africa, Asia, the Americas, Europe and Oceania, and covers the period from December 8, 2019 to May 5, 2020. The selection of this sample is dictated by the availability of data on Covid-19-related infections and deaths. These

data are derived from the Johns Hopkins University Coronavirus Resource Centre database and *the OxCGRT index database at* Oxford University. We are particularly interested in the impact of the quality of public governance on the spread and mortality of the pandemic.

The first main dependent variable is the rate of spread. This variable is defined by Zimmermann et al. [6], which corresponds to the speed with which the disease is transmitted from China to the country concerned and within each country. It is determined by the product between the duration and rate of infection. Duration is the time (in days) between the date of discovery of the virus in China and the date on which it appears in a country. The second dependent variable is the infection rate. It's represent the ratio of the total number of coronavirus cases detected to the size of the population. The level of infection and mortality refer to the logarithm of the total number of covid-19 cases and the total number of deaths in the country, respectively.

With regard to factors related to public governance, three indicators are also selected. The first is the government's response time (RT). This variable corresponds to the time (in days) between the detection of the first case in a country and the first response measures taken by the government. It is calculated using the following equation:

$$\mathrm{RT} = \mathrm{dFM} - \mathrm{dFI} \quad (1)$$

In this equation, RT represents the government's response time, dFM the date on which the first measures were taken, and dFI the date of detection of the first official case of Covid-19 infection in the country. The values of this variable range from -67 to 53. The first value (-67) is an early reaction and indicates that in this country, the authorities took the first preventive measures 67 days before the first case of virus infection was detected. The second value corresponds to a delayed reaction time, indicating that the public authorities took the first measures 53 days after the first case appeared.

The second is the nature of the government's initial measures (NIM). It is defined from the reaction time and reports on the point at which the government reacted to implement the first measures. Two types of reaction are observed, those by anticipation and, those by adaptation. In the first case, the government takes the first steps before the pandemic breaks out in the country. The measures taken are then aimed at delaying the entry of the virus into the country. In the second case, the government reacts after the virus has been declared in the country in order to limit the internal transmission of the virus. This variable is constructed from equation (2) below:

$$\mathrm{NIM_i} = \begin{cases} 1 \text{ if early reaction in country i } (\mathrm{RT} \leq 0) \\ 0, \text{otherwise} \end{cases} \quad (2)$$

The third variable of interest corresponds to the magnitude of the first reactions (MFM_i). It provides a measure of the rigour with which the government first responded to the Covid-19 pandemic. It includes two indicators: the number of actions taken in the initial response and the average level of rigour of those actions. The data for this variable come from *the OxCGRT index* database. The overall magnitude of the initial response is given by the relationship:

$$\mathrm{MFM_i} = (\mathrm{NM_i} \times \mathrm{RM})/100 \quad (3)$$

With NM_i the number of measures taken on the government's initial response and RM the rigour of these measures. The values of this variable range from 0 to 32. Thus, the further away from 0, the greater the magnitude of the first reaction.

2.2 The Econometric Model

The methodological approach is based on cross-sectional analysis and draws on the work of Zimmermann et al. [6]. The econometric model is specified as follows:

$$\mathrm{Corona_i} = \gamma_0 + \gamma_1 \mathrm{QRG_i} + \gamma_2 \mathrm{X_i} + \gamma_3 \mathrm{DUM} + \varepsilon_i \quad (4)$$

With QGR_i the quality of the government response in country i which alternatively includes the government's response time, the nature of the initial measures and the extent of those measures. $X$is a matrix of control variables and γ_0 the constant of the model. The matrix X includes variables such as social globalization, latitude, longitude, proportion of population over 64 years of age. The use of these variables is dictated by the Covid-19 literature [6]. In equation (4) DUMrepresents a matrix of binary variables that captures the influence of geographical location and level of development of countries on the spread of Covid-19. The above model is estimated by the OLS method. This technique allows correcting for heteroscedasticity problems that could affect the significance of the coefficients. Table 1 presents the descriptive statistics of the variables used in our study.

Table 1. Descriptive statistics

Variable	I	Averages	Std. Dev.	Minimum	Maximum
Infections (in logarithm)	129	7524	2.566	2.079	13.998
Death Covid-19 (logarithmic)	120	4.347	2.565	0	11.141
Government response time	129	-10.713	23.601	-67	53
Rate of spread of the virus	129	107.698	22.169	0	186
Number of measures at first reaction	127	1.409	0.867	1	6
Magnitude of the first measurements	127	15.36	12.436	0	56.67
Nature of the first reaction	129	0.612	0.489	0	1
Population over 64 years of age	129	7.107	4.788	1.042	17.826
Social Globalization	129	48.746	22.998	12.613	92.104
Longitude	129	15.535	56.434	-106.347	149.012
Latitude	129	20.008	24.985	-38.416	71.707
Africa	129	0.31	0.464	0	1
Asia	129	0.24	0.429	0	1
America	129	0.178	0.384	0	1
Europe	129	0.248	0.434	0	1
Level of development	126	0.19	0.394	0	1

Source: The authors

The data in Table 1 indicate that the spread and mortality of Covid-19 vary considerably from country to country. The standard deviations of the rate of spread, infection rate and mortality rate are around 2.5. These figures are relatively high and reflect the existence of a wide dispersion of observations of these variables around their averages. Table 1 also shows that there is a large discrepancy between the maximum and minimum value for each of the three coronavirus-related variables. In terms of mortality, it appears that as of 5 May 2020, some countries such as Mozambique, Dominica, Lao Popular Democratic Republic, Namibia and Papua had not yet recorded any Covid-19 related deaths. However, countries such as France, Spain, the United Kingdom and the United States at the same date each recorded more than 20,000 deaths. Referring only to this table, one could attribute these disparities to the high variability of public governance acts such as the reaction time, the scale of first reactions, the size of the population or the level of globalization. Thus, an econometric analysis makes it possible to establish the empirical relationship that exists between governance and the spread of the virus in the world.

3. RESULTS AND DISCUSSIONS

We first present the basic results obtained by estimating the effect of reaction time and the nature of the first reaction on the speed of spread, level of infection and mortality of the virus. Then, we proceed to a sensitivity and robustness analysis of the results by taking into account the magnitude of the first reactions, the geographical location of countries according to continents and the level of development.

3.1 Basic Findings

Table 2 presents the results of regressions of the effect of governance on the coronavirus pandemic. Columns (1) and (2) correspond to the speed of spread of the virus around the world. Columns (3) and (4) are the number of officially reported infections and the last two columns show the number of deaths. It can be seen from this table that the government response time significantly increases the rate of spread, the number of infections and the mortality of Covid-19. A one-unit increase in reaction time increases the rate of spread, the number of infections and the number of deaths by 12.1%; 13.7% and 15.3%, respectively. This result explains why countries such as Belgium, Germany, the United Kingdom, the United States and Spain have the highest levels of infections and mortality, correlating with the time their governments has taken to respond to the pandemic. In Belgium and Germany, for example, the first measures were taken 30 days after the first case of infection was detected, 48 days after in the UK and 13 days after in the USA.

This result also partly explains the resilience of the African continent, which has relatively lower levels of infections and mortality. Indeed, most African countries took restrictive measures such as closing borders, banning gatherings and

closing schools long before the virus entered their territories. The most affected countries on the African continent are also those with long government response times. This is the case of Algeria, which has a response time of 9 days, 7 days in Cameroon, 30 days in Egypt and 05 days in Côte d'Ivoire.

Our results also show that the nature of the first reaction significantly affects the spread rate, level of infection and mortality of the new coronavirus. The coefficient of this variable is negative and statistically significant. This result shows that, on average, anticipatory measures are more effective than adaptive measures in controlling the spread and mortality of pandemic diseases in general and the specific case of Covid-19. This result corroborates the analysis of the stylized facts that some developing countries have relatively low infection and contamination rates, correlating with the early nature of the response measures put in place in these countries. In developed countries, on the other hand, responses have been broadly adaptive. These results on the impact of public governance complement the work of Zhan et al. (2020), Fang et al. [2] and Zimmermann et al. [6] whose studies focus on the propagation factors of COVID-19.

3.2 Sensitivity Analysis of the Main Results

This sub-section is devoted to the sensitivity analysis of our results. In doing so, we take into account the level of rigour of the initial measures taken by governments to respond to the evolution of the pandemic. Indeed, some governments initially imposed more flexible measures, before tightening up as the pandemic evolved. In contrast, other countries immediately imposed strict measures such as closing schools and borders and restricting the movement of people. These differentials in acts of governance are likely to impact the evolution of the virus as well as its mortality.

The results in Table 3 show that the extent of the initial measures negatively affects the speed of spread, level of infection and mortality of the new corona virus. Indeed, the stricter the initial government measures, the less severe the consequences of the pandemic. This result shows that it is not enough for a government to react in advance to reduce the transmission and fatality of the virus. The response must also be consistent. This makes it possible to understand the case of France and Italy, whose initial measures were relatively flexible, although taken

Table 2. The effect of response time on the coronavirus pandemic

	Propagation speed		Log Infections		Log death	
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Reaction time	0.121***		0.137***		0.153***	
	(0.041)		(0.042)		(0.045)	
Nature first reaction		-0.804**		-0.942**		-1.111***
		(0.364)		(0.379)		(0.418)
Social Globalization	0.036***	0.038***	0.040***	0.042***	0.009	0.011
	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)	(0.009)
Population over 65 years of age	0.030	0.038	0.032	0.040	0.183***	0.192***
	(0.044)	(0.045)	(0.046)	(0.047)	(0.050)	(0.053)
latitude	0.015*	0.016*	0.015*	0.016*	0.009	0.010
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
longitude	-0.0007	-0.0005	0.001	0.001	-0.0008	-0.0005
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	10.13***	10.20***	5.288***	5.394***	2.586***	2.798***
	(0.423)	(0.492)	(0.438)	(0.510)	(0.470)	(0.572)
Fischer	20.95***	18.62***	22.60***	19.66***	16.39***	13.50***
Countries	128	128	129	129	120	120
R-square	0.380	0.362	0.398	0.379	0.378	0.360

Source: The authors

Note: Values in parentheses represent heteroscedasticity adjusted standard deviations and stars indicate the significance threshold at 1% (***), 5% (**) and 10% (*)

before the arrival of the pandemic. This did not prevent these two countries from being among the most affected by Covid-19 in the world ranking. In the case of France and Italy, the first measures taken 3 and 8 days before the first contamination respectively only concerned the temperature control of passengers arriving from abroad. Thus, the level of rigour of this measure in both countries is only 2.67 according to the OxCGRT database index.

Our results also show that there is a significant regional effect in the spread and mortality of the coronavirus. We introduce dichotomous variables into the estimates that indicate the continent to which each country belongs. The coefficients for Europe and Asia are found to be positive and significant, while they are non-significant for Africa and America. This result shows that Asia and Europe are on average more affected than the rest of the world. In the case of Asia, this result can be explained by the fact that this continent is the starting point of the pandemic. As a result, Asian countries have been caught up in the pandemic and have not been able to anticipate the measures to be put in place to stop the spread of the virus. In the case of the European continent, this result is in fact based on the laxity of governments, which generally reacted late and whose initial response measures were relatively flexible.

3.3 Robustness Checks

We analyze the robustness of the results discussed in the previous two subsections by distinguishing countries according to their level of

Table 3. Sensitivity results for the magnitude of the first government's measures

	Propagation speed		Log infections		Log death	
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Reaction time	0,171***		0.191***		0.237***	
	(0.046)		(0.046)		(0.051)	
Nature first reaction		-1.363***		-1.534***		-1.928***
		(0.367)		(0.370)		(0.416)
Amplitude of the First. React.	-0.033**	-0.032*	-0.039**	-0.037**	-0.056***	-0.054***
	(0.015)	(0.016)	(0.015)	(0.017)	(0.017)	(0.020)
Social Globalization	0.017	0.018	0.021*	0.022*	-0.003	-0.001
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)
Population aged 65 and over	0.096	0.131**	0.114*	0.151**	0.223***	0.276***
	(0.064)	(0.061)	(0.066)	(0.064)	(0.075)	(0.072)
latitude	0.002	0.003	0.004	0.005	0.0006	0.004
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)
longitude	-0.007	-0.007	-0.004	-0.005	-0.006	-0.006
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)
Africa	0.636	0.758	0.862	0.965	0.584	1.159
	(1.148)	(1.025)	(1.194)	(1.053)	(0.910)	(0.859)
Asia	2.653***	2.902***	2.896***	3.141***	2.014**	2.677***
	(1.012)	(0.823)	(1.058)	(0.843)	(0.785)	(0.697)
America	0.855	0.904	1.260	1.252	0.850	1.329
	(1.495)	(1.435)	(1.512)	(1.451)	(1.237)	(1.128)
Europe	1.461	1.298	1.446	1.250	1.074	1.086
	(0.995)	(0.918)	(1.035)	(0.949)	(0.695)	(0.715)
Constant	10.23***	10.32***	5.144***	5.294***	3.138**	2.882**
	(1.444)	(1.384)	(1.493)	(1.428)	(1.285)	(1.293)
Fischer	15.09***	13.82***	16.22***	15.30***	12.24***	11.38***
Countries	126	126	127	127	118	118
R-square	0.465	0.450	0.494	0.479	0.471	0.458

Source: The authors

Note: Values in parentheses represent heteroscedasticity adjusted standard deviations and stars indicate the significance threshold at 1% (***), 5% (**) and 10% (*). First. React. : First government's reaction

Table 4. Robustness of results in relation to the level of economic development

	Developing countries			Developed countries		
	V.prop	Log Infect.	Log death	V.prop	Log infect.	Log death
Variables	**(2)**	**(4)**	**(6)**	**(1)**	**(3)**	**(5)**
Reaction time	0.089	0.120*	0.122*	0.538***	0.585***	0.652***
	(0.063)	(0.064)	(0.067)	(0.171)	(0.179)	(0.154)
Nature first reaction	-0.978*	-1.193**	-1.482**	1.615	1.715	1.505
	(0.530)	(0.531)	(0.577)	(1.093)	(1.134)	(1.192)
Amplitude of the First. React.	-0.040**	-0.051***	-0.082***	-0.031	-0.033	-0.023
	(0.019)	(0.019)	(0.019)	(0.029)	(0.030)	(0.030)
Social Globalization	0.014	0.0167	-0.005	-0.031	-0.033	-0.043
	(0.013)	(0.013)	(0.011)	(0.039)	(0.040)	(0.042)
Population aged 65 and over	0.085	0.109	0.223***	0.250	0.278	0.416
	(0.064)	(0.065)	(0.071)	(0.227)	(0.237)	(0.268)
longitude	-0.013**	-0.011**	-0.006	-0.007	-0.006	-0.013
	(0.005)	(0.005)	(0.006)	(0.007)	(0.008)	(0.008)
Africa	0.345	0.318	-0.311	-2.000	-2.165	-1.223
	(0.808)	(0.835)	(0.994)	(1.829)	(1.841)	(2.019)
Asia	2.752**	2.847**	1.105	3.286	3.211	5.110**
	(1.096)	(1.123)	(1.206)	(1.960)	(2.052)	(2.227)
Europe	1.509*	1.310	0.206	-0.637	-0.918	-0.632
	(0.787)	(0.823)	(0.910)	(1.467)	(1.556)	(1.582)
Constant	11.33***	6.739***	5.173***	13.12***	8.537**	3.933
	(0.983)	(0.999)	(1.051)	(2.883)	(3.017)	(3.263)
Fischer	10.21***	11.60***	8.02***			
Countries	99	100	91	24	24	24
R-square	0.412	0.453	0.430	0.688	0.702	0.742

Source: The authors

Note: Values in parentheses represent heteroscedasticity adjusted standard deviations and stars indicate the significance threshold at 1% (***), 5% (**) and 10% (*). V.prop.: Propagation velocity; Infect.Number of cases of infections detected. First. React. : First government reaction

development. To do so, we divide our sample into developed and developing countries. The results obtained and presented in Table 4 show that the governance variables retain their signs and remain significant overall. Indeed, the response time increases the speed of spread, the level of infection and mortality of Covid-19 in both developed and developing countries. However, the nature of the first reaction is negatively related to the transmission and mortality of Covid-19 in DCs. In developed countries, on the other hand, the coefficient of this variable changes sign and loses its significance. This result could explain the fact that very few developed countries have reacted to the pandemic in an anticipated manner. Even if they did, the reaction was very weak. The magnitude of the initial reaction also has a significant effect in developing countries and retains the same sign as in the overall sample. In the developed country sub-sample, the coefficient also retains the sign with a non-significant effect.

4. CONCLUSION REMARKS AND IMPLICATIONS

The objective of this study is to analyze the effect of public governance on the spread and mortality of Covid-19. The analysis is based on the finding that the countries most affected by the pandemic are those whose governments have been slow to respond to the global spread of the pandemic. Based on these observations and the literature on the factors that explain the spread of infectious diseases, we hypothesize that the delay in government response explains the spread and mortality of this virus. Empirical tests of this hypothesis are carried out on a sample of 129 countries in Africa, Asia, America, Europe and Oceania. The study period is from December 8, 2019 to May 5, 2020. The regressions are

implemented in cross-sections using the OLS technique.

The results show that government response time significantly increases the rate of spread, level of infection and mortality of Covid-19. In addition, the results indicate that the nature and extent of the initial government response significantly affects the rate of spread, level of infection and mortality of Covid-19. These results extend those of Fang et al. [2], Zhang et al. [7] and Zimmermann et al. [6] who analyzed the factors that explain the spread of the new coronavirus.

Our review contributes to the existing literature in that it relates to the economics and epidemiological literature of factors influencing the spread of pandemic infectious diseases [7,2,9,13,15,16]. In addition, we explain the average number of cases of illness or death directly caused by the laxity of some governments in taking rapid response measures against the spread of the pandemic. Finally, our study is the first, to our knowledge, to use the response time of governments as an explanatory factor for the spread and mortality related to Covid-19. We recommend that public decision-makers should be more rigorous and responsive in the implementation of response measures to pandemic diseases. Indeed, the experience of Covid-19 shows those rigorous and prompt public decisions contribute significantly to containing and limiting the spread and mortality of pandemic diseases, which have serious economic and social consequences.

ETHICAL APPROVAL

The authors declare that all ethical recommendations has been respected.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

Table A2. List of countries by region

Africa		America		Asia		Europe		Oceania
South Africa	Madagascar	Argentina	Suriname	Afghanistan	Oman	Albania	The Netherlands	Australia
Algeria	Malawi	Barbados	Trinidad and Tobago	Saudi Arabia	Uzbekistan	England	Poland	New Zealand
Angola	Mali	Bolivia	Uruguay	Bahrain	Pakistan	Austria	Portugal	Papua
Benin	Morocco	Brazil	United States	Bangladesh	Philippines	Azerbaijan	Republic Czech	
Botswana	Mozambique	Canada		China	Qatar	Belgaum	Romania	
Burkina Faso	Namibia	Chile		Emirates United Arab	Singapore	Bosnia	Russia	
Burundi	Niger	Costa Rica		India	Sri Lanka	Bulgaria	Serbia	
Cameroon	Nigeria	El Salvador		Indonesia	Syria	Cyprus	Slovakia	
Cape Verde	Rwanda	Ecuador		Iran	Thailand	Denmark	Slovenia	
Ivory Coast	Seychelles	Guatemala		Iraq	Turkey	Estonia	Spain	
Djibouti	Sierra Leone	French Guiana		Israel	Venezuela	Finland	Sweden	
Egypt	Somalia	Honduras		Japan	Vietnam	France	Switzerland	
Ethiopia	Sudan	Jamaica		Jordan		Greece	Ukraine	
Gabon	Tanzania	Mexico City		Kazakhstan		Ireland		
The Gambia	Chad	Nicaragua		Kyrgyzstan		Iceland		
Ghana	Tunisia	Panama		Kuwait		Italy		
Mauritius	Uganda	Paraguay		Lebanon		Luxembourg		
Kenya	Zambia	Peru		Malaysia		Moldova		
Liberia	Zimbabwe	Republic Dominican Republic		Mongolia		Norway		
Libya								

Source: Theauthors

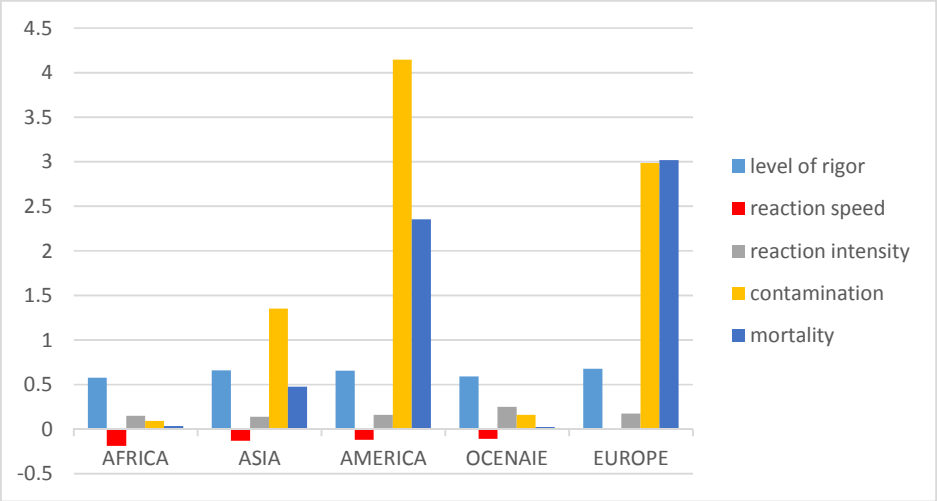

Fig. A1. Evolution of Covid-19 in decreasing order of government's responsiveness around the world

Source: Authors' construction using data from the OxCGRT index database

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