WORKING PAPER

Identification of country resilience factors to COVID-19: a time series, cross- country analysis

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EMNES Working Paper N° 47 / March, 2021

Abstract

On March 11, 2020, the World Health Organisation (WHO) qualified COVID-19 as a pandemic. Since that date, it has circulated across the vast majority of countries around the world. The available figures show that some countries are experiencing a favourable trend, whilst others are still struggling to control the development of the virus. What explains these differences in performance?

In this paper, we attempt to answer this question by conducting several cross country analyses on COVID-19 figures, covering 147 countries around the world, between April and September 2020. The objective is to find causal relationships between potential factors of resilience and performance in the COVID-19 severity measurement and monitoring index, designed by the Economic Prospective Bureau (Bureau de Prospective Economique, BPE) of Senegal. These potential factors of resilience have been selected according to the related literature and can be both structural and/or linked to disease governance measures.

We find evidence that taking restrictive measures with broad parameters and a strong level of stringency, very early in the fight against the pandemic, is preferable to the following two options: (i) a strategy which would consist of localising restrictions and only very stringently in certain areas and (ii) a strategy which consists of adjusting the level of restrictions even with broad parameters to the evolution of the pandemic.

Furthermore, our analyses robustly show that structural factors such as low population density, incidence of malaria and the continent all explain resilience to COVID-19.

Keywords: COVID 19, resilience, severity, survival

JEL Classification: C21, C23, C43, I12.

This study benefitted from intensive discussions during research sessions between the authors and Prof Rym Ayadi and Sara Ronco, both from EMEA, and from the review made by Dr Racha Ramadan during the presentation of the draft paper at the EMNES annual conference, held virtually in December 2020.

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Introduction

On March 11, 2020, the World Health Organisation (WHO) qualified the COVID-19 virus, which originated in China in December 2019, as a pandemic. Since that date, it has circulated across all continents and to the vast majority of countries and territories around the world (based on the United Nations Geoscheme list of countries and territories).

As of September 27, 2020, the world had recorded around 32,920,218 declared COVID-19 cases and nearly one million deaths (WHO).

The United States is the most affected country, with 204,497 deaths from 7,078,798 cases. Brazil follows with 141,406 deaths from 4.7 million cases, India with 94,503 deaths (with around 6 million cases) and Mexico with 76,243 deaths (from 726,431 cases).

The increasing spread of the coronavirus across countries has prompted many governments to introduce unprecedented measures to contain the epidemic.

An examination of the available figures shows that some countries are experiencing a favourable trend (with a concomitant slowing down of new infections, a continuous increase in recoveries and a decrease in disease-related deaths), whilst others are still struggling to control the development of the virus and its negative consequences on the lives of the sick.

In order to monitor the respective performances of countries in their strategies for fighting the virus, the Economic Prospective Bureau (Bureau de Prospective Economique (BPE)of Senegal has constructed a synthetic COVID-19 severity index[4]. The index aims to assess the situation of countries concerning the disease, at any time, in order to estimate instantaneously the severity of the pandemic in different countries and to identify groups of performing countries.

Measuring the severity of COVID-19 through a severity index naturally raises the question about the real causes of the differences in performances between countries. Those factors of resilience, that may have been at the root of the successes achieved by some countries, could be structural and/or related to policies that governments have taken to respond to the pandemic.

The objective of this document is to analyse the various potential resilience factors, using statistical and econometrical methods, in order to identify those, among them, that could explain why some countries are performing better than others regarding the fight against COVID-19.

This analysis would guide policies towards the implementation of effective combinations of measures to mitigate or stop the spread of the disease

The document is divided into three parts. The first presents the severity index constructed by the BPE and uses it to follow the evolution over five months (April to September 2020) of COVID-19 severity at a global level. The second reviews the literature on the possible

[4] 4 Moubarack LO and Amaye SY (2020), « A COVID-19 Severity Index », EMNES Working Paper No 32 / June 2020

factors of resilience to COVID-19 that will guide the collection of data. The third part presents the data collected on the potential factors of resilience and the methodology for identifying the factors that have a significant impact on the performance of countries in terms of resilience.

A COVID-19 severity index to measure resilience to the pandemic

The objective of this section is to present the COVID-19 severity measurement and monitoring index, designed by the Economic Prospective Bureau (Bureau de Prospective Economique, BPE) of Senegal.

As of September 27, 2020, COVID-19 disease affected all countries and territories around the world (based on the United Nations Geoscheme list of countries and territories). As of the same date, the world recorded around 32,920,218 declared COVID-19 cases and nearly one million deaths (WHO).

We follow the definition of the severity of a viral pandemic, adopted by the WHO, which integrates three elements: the transmissibility of the virus, the severity of the disease and its impact.

Based on this approach and given the availability of regular data for a large sample of countries, six variables grouped in three dimensions (infections, recoveries and deaths) were selected to make up the COVID-19 severity index. These are: (i) the infection rate (number of cumulative infections in relation to the size of the population), (ii) the progression of new infections in the recent period, (iii) the cure rate (ratio of the number of cured to the number of infected in the previous period), (iv) the progression of recoveries over a period as a ratio of the sum of new infections over a period (we call it the "control or mastery rate"), (v) the flow of new deaths over a period as a ratio of the number of infected in the previous period, and (vi) the case-fatality rate (ratio of the number of deaths to the number of infected). In the future, other variables of lasting health-related impacts could be studied. For each country, the highest the index score, the lowest the severity of the disease.

The severity index is calculated on a weekly basis for 166 countries for which data exist. This comes from the World Health Organisation (WHO) and from the website https://epidemic-stats.com/coronavirus. The methodology of the index has been published in a working paper at Emnes[5].

[5] Moubarack LO and Amaye Sy (2020), " A COVID-19 SEVERITY INDEX », EMNES Working Paper No 32 / June 2020

The overall severity of the COVID-19 went from a score of 0.68 to a score of 0.83 over the period from April 14 to September 27, 2020. This increase in index value means a reduction in the severity of COVID-19 worldwide. On September 27, 2020, the highest scores were recorded by Oceania (0.97), Africa (0.87) and Asia (0.86). On the same date, Europe (0.73) and America (0.81) were the continents with the highest levels of pandemic severity (i.e. the lowest scores in the index). The ranking by continent is reproduced in table 8 in the annexes.

In Africa, the severity of COVID-19 decreased between April 14 and September 27, 2020. Indeed, the average score in Africa increased from 0.71 on April 14 to 0.87 on September 27, 2020. Across the continent, 70% of countries noted a decrease in the severity of the pandemic. Ghana, Liberia, Gabon, Somalia and Côte d'Ivoire showed the largest decreases in severity over five months, whilst South Africa, Botswana, and Burundi showed the largest increases in severity.

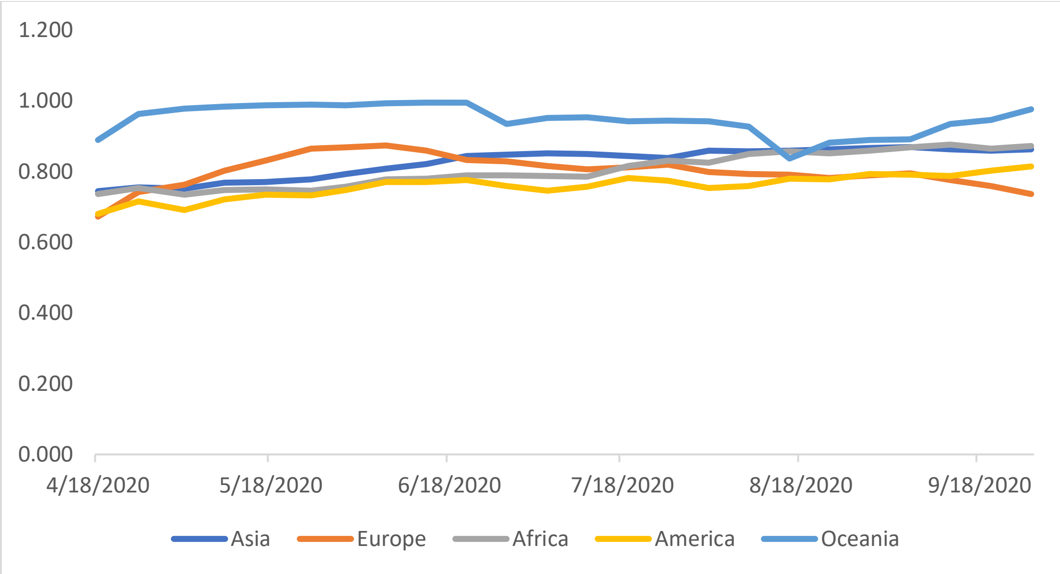
Europe was the continent most affected by the COVID-19 pandemic as of September 27, 2020. Although it recorded the second highest score after Oceania on July 7, a sharp decrease in the severity index score took place in Europe between June and September 27, 2020. Across this continent, Norway, Serbia and Cyprus show the largest increases in the index score over the five months, whilst Spain, France, Denmark and Iceland show the largest decreases.

America was the second-most affected continent by the pandemic, behind Europe, as of September 27, 2020. The average score in America rose from 0.65 on April 14 to 0.81 on September 27. However, the level of severity has decreased in the majority of American countries compared to April 14, 2020. Haiti, Panama and Guatemala posted the largest increases in the index score over the five months, whilst Nicaragua, Jamaica and Costa Rica recorded the largest decreases.

Asia was the second-least affected COVID-19 continent at the end of September 2020. The average score in Asia rose from 0.73 on April 14 to 0.86 on September 27. During the same period, the severity of the COVID-19 on this continent has continued to decrease. In Asia, Singapore, Qatar, Turkey and Japan posted the highest increases over five months, whilst South Korea, Jordan, Iraq and the Maldives recorded the largest decreases.

The continent least affected by the severity of COVID-19 as of September 27, 2020, Oceania, recorded a score of 0.97 points on that date. The average score in Oceania rose from 0.75 on April 14 to 0.97 on September 27, an increase of 0.22 points. Australia, French Polynesia and Fiji show the largest increases over five months, whilst New Caledonia and New Zealand show the largest decreases.

Figure 1: Changes in index scores by continent



<u>Source</u>: Economic Prospective Bureau

Although the number of people infected since the start of the pandemic is increasing, performance is noted in the cure rate and the pandemic control rate. On top of this, the death flow score is continually increasing and reached its maximum score at the end of August 2020, which corresponds to a sharp decrease in the number of deaths in COVID-19. The indicator for the progression of new cases shows an increasingly higher score evolution, which means a reduction in the speed of progression of new cases worldwide.

Factors of resilience: related literature

In this part, we review the scientific literature relating to the factors that have been tested as potential factors having an impact on one or more of the dimensions of severity (infections, deaths, cures). These potential factors of resilience can be both structural (intrinsic quality of the health system, size and generational structure of households, age pyramid, climate, etc.) and/or linked to disease governance measures (screening strategies, population protection strategies, patient management strategies). The review is structured according to this categorization

Structural causes of resilience

The intrinsic quality of the health system

The capacity of health systems to respond to the sharp increase in demand for care associated with COVID-19 cases is one of the main challenges facing countries. The growing demand could put particular pressure on access to consultations, diagnosis, hospitalisation and intensive care for the most complex cases. Countries with a good quality healthcare system are, at first glance, more likely to cope with the severity of the virus in a sustainable manner. Wong and al. (2020)[6] have evaluated the association between public health preparedness actions, capacity building initiatives and disease mitigation strategies, as measured by the Global Health Security (GHS) index (see Box 1 below), which is a comprehensive evaluation of the capabilities of global health security in 195 countries, in relation to the control of the COVID-19 pandemic, as measured by the rate of incidence and mortality increase per population in different countries. A linear regression analysis was performed with different COVID-19 incidence/mortality rates as outcomes, whilst allowing for Human Development Index (HDI), Gross Domestic Product (GDP) and the population density of each country. The GHS index was found to be a significant predictor of COVID-19 pandemic control.

[6] Wong et al. (2020)"Is the Global Health Security (GHS) Index a Significant Factor Associated with COVID-19 Control? A Country Level Analysis" ,(4/17/2020). Available at SSRN: https://ssrn.com/abstract=3582746 or http://dx.doi.org/10.2139/ssrn.3582746

Box 1: The Global Health Security Index (GHS)

The Global Health Security Index (GHS) is the first comprehensive assessment and comparative analysis of health security and related capacities in the 195 countries that make up the member states of the International Health Regulations (IHR [2005]). The GHS Index is a project of the Nuclear Threat Initiative (NTI) and the Johns Hopkins Centre for Health Security (JHU) and was developed with The Economist Intelligence Unit (EIU).

It is based on a detailed and comprehensive framework of 140 questions, divided into 6 categories (prevention, detection and reporting, rapid response, health system, compliance with international standards, environment at risk), 34 indicators and 85 sub-indicators to assess a country's capacity to prevent and mitigate epidemics and pandemics.

The WHO IHR (2005) is the fundamental international standard for health. The IHR (2005) is a binding legal instrument to combat cross-border public health risks. The objective of the IHR (2005) is to prevent, protect, control and respond without disrupting international trade and traffic. The IHR (2005) provided the guiding regulations behind many of the indicators included in the GHS Index.

Kushan T. et al (2020)[7] explore the association between the spread of COVID-19 and external parameters. In this regard, temperature, population size, median age and healthcare facilities of 58 different countries are considered as external factors. A negative binomial regression model was fitted to identify the associations between the factors and cases of COVID-19 during the study period. Their results show that "*there is no evidence supporting that case counts of COVID-19 could decline in countries with better health care facilities*".

The population density:

Bhadra, A. et al. (2020)[8] performed a detailed analysis of COVID-19-infected and death cases as a function of population density of Indian districts. After a detailed correlation and regression analysis of infection and mortality rates due to COVID-19 at the district level (in India), a moderate association between COVID-19 spread and population density is found.

Vishalkumar J. et al. (2020) use a countrywide number of corona cases and deaths and analyse them in a cross-country multivariate regression framework. They use gross domestic product per capita, average temperature, population density and median age as independent variables. The study uses testing data as a control variable. They found that "*The population density, median age, climate do not have significant impact. The countries with higher population density have lower deaths.*"

[7] Kushan T. et al (2020) « The impact of temperature, population size and median age on COVID-19 (SARS-CoV-2) outbreak »;, Clinical Epidemiology and Global Health, https://doi.org/10.1016/j.cegh.2020.09.004

[8] Bhadra, A., Mukherjee, A. & Sarkar, K. Impact of population density on COVID-19 infected and mortality rate in India. *Model. Earth Syst. Environ.* (2020). https://doi.org/10.1007/s40808-020-00984-7

The distribution of certain risk factors in the population (age, weight, chronic diseases, gender):

COVID-19 deaths are highly concentrated in the older population (65 and over) and amongst people with pre-existing cardiovascular disease, especially hypertension and coronary heart disease[9] (Flaherty, G. et al).

Ciminelli and Garcia-Mandicó (2020)[10] analyse daily death registry data for a sample of 1,161 Italian municipalities in the seven regions most severely hit by COVID-19. They show that mortality increases exponentially with age, but at much higher levels for men: the effects of COVID-19 in men are three times those for women. These results confirm that gender differences play a crucial role in understanding the distribution of risk from the epidemic (Wenham et al. 2020)[11].

Blood group may influence coronavirus resistance, according to a study by Jiao Zhao and Al (2020)[12]. The researchers observed the distribution of blood groups in 2,173 COVID-19 infected patients from three hospitals in Wuhan and Shenzhen, comparing it with that of uninfected individuals. They concluded that "blood group A is associated with a higher risk of contracting COVID-19 compared to other blood groups, while blood group O is associated with a lower risk".

Fakhry A. et (2020)[13] carry out a retrospective study in which the rate of COVID-19 deaths was correlated with each of the following independent variables: total tests per 1 million population, gross domestic product (GDP), average temperatures per country, ultraviolet index, median age, average BMI (Body Mass Index) per country, food supply, Bacille Calmette-Guerin compulsory status and passenger traffic. They concluded that "BMI per country proved to be the second-best predictor of death rate with an R value of 0.43 and GDP being the best predictor with $R = 0.65$".

The country's exposure to malaria and the vaccination of children with BCG:

Some experts postulate that countries exposed to malaria, or whose children are vaccinated early with BCG, would be less affected by COVID-19 than other countries. This

[9] Flaherty, G.. et al. "COVID-19 in adult patients with pre-existing chronic cardiac, respiratory and metabolic disease: a critical literature review with clinical recommendations." *Tropical diseases, travel medicine and vaccines* vol. 6 16. 28 Aug. 2020, doi:10.1186/s40794-020-00118-y

[10] Ciminelli, G, and S Garcia-Mandicó (2020), "COVID-19 in Italy: an Analysis of Death Registry Data," mimeo.

[11] Wenham, C, J Smith, and R Morgan (2020), "COVID-19: the gendered impacts of the outbreak", *The Lancet* 395(10227): 846-848.

[12] Zhao Jiao and Al. (2020), " Relations between the ABO Blood Group and the COVID-19 susceptibility ", Janvier 2020, https://www.medrxiv.org/content/10.1101/2020.03.11.20031096v2

[13] Fakhry AbdelMassih, Antoine et al. "Obese communities among the best predictors of Covid-19-related deaths." *Cardiovascular endocrinology & metabolism* vol. 9,3 102-107. 11 Jun. 2020, doi:10.1097/XCE.0000000000000218

thesis has been put forward, amongst other things, to explain the low extent of coronavirus disease in Africa, even though the numbers are increasing.

Tareef Fadhil Raham (2020)[14] discovered that "*standardised TB prevalence to BCG coverage is significantly associated with reduced COVID-19 mortality and malaria incidence have an additional highly significant effect in reducing COVID-19 mortality*".

Muneer A. and Al (2020)[15] found that "*the malaria free countries not only have higher density of COVID-19 infections but also higher case fatality rates as compared to highly malaria endemic countries"*. They then postulated that *"natural immune response against malaria infection is providing a heterologous protection against the virus*".

Miller and al. (2020)[16] compared BCG vaccination policies with the morbidity and mortality for COVID-19 for middle-high and high-income countries. They found that countries without universal policies of BCG vaccination (Italy, the Netherlands, the USA) have been more severely affected compared to countries with universal and long-standing BCG policies. Difference cannot be accounted for by differences in disease onset, adoption of early social distancing policies, state of health services, nor income level.

LI et al. (2020)[17] et al. adopt different data to check this correlation but find that the correlation is not significant, in general, between countries with or without BCG. It is only marginally significant amongst countries with BCG when median age is also considered.

Bluhm and al (2020)[18] exploit a natural experiment, overlaying the large difference in BCG vaccination rates with the large differences in COVID-19 infection rates between the former East and West Germany. They find that the differences are attributable not to BCG, but to the West's copious commuter flow patterns and the fact that the epidemic arrived there first.

The national culture:

Social and cultural norms that impose self-discipline and obedience to official advice, which encourage people not to cause problems for others, may be one of the reasons why some Asian countries have so far managed to limit the number of infections. Moreover, in East Asia, the wearing of facemasks is often seen as a collective responsibility to reduce disease

[14] Raham T. F. (2020), "Malaria Endemicity Influence on COVID-19 Mortality: New Evidence Added to BCG and TB Prevalence", medRxiv preprint doi: https://doi.org/10.1101/2020.09.09.20191684

[15] Muneer A. and Al (2020), "Comparative analyses revealed reduced spread of COVID-19 in malaria endemic countries" medRxiv preprint doi: https://doi.org/10.1101/2020.05.11.20097923

[16] Miller et al.(2020) "Correlation between universal BCG vaccination policy and reduced morbidity and mortality for Covid-19: an epidemiological study". medRxiv.

[17] Li et al.(2020) "The Correlation between BCG Immunisation Coverage and the Severity of COVID-19" ; April, 2020)". Available at SSRN: https://ssrn.com/abstract=3568954 or http://dx.doi.org/10.2139/ssrn.3568954

[18] Bluhm, R and M Pinkovskiy (2020), "The Spread of COVID-19 and the BCG Vaccine: A Natural Experiment in Reunified Germany", CEPR *Covid Economics*, 19: 87-114.

transmission and can symbolise solidarity, particularly since the SARS outbreak in 2002-2004.

Platteau et al (2020)[19] argues that differences in the way people and, in particular, different age groups interact can explain part of the variation in infection and death rates, both across as well as within countries. Their simulations show that "*the measures Belgium would need to take when re-opening its economy would be more moderate if it had the same interaction patterns as Germany, and more strict if it had Italy's interaction patterns*".

Lessons from past epidemic outbreaks

According to Gaye B. et al. (2020)[20] from the Leverhulme Centre for Demographic Science in Oxford, the experience of tackling other epidemics (like Ebola) has helped African countries cope with the pandemic relatively well so far.

Temperature:

Jingyuan Wang, Kai Feng, Weifeng Lv and Ke Tang (2020) (2020)[21] find that a one-degree Celsius increase in temperature and a one-percent increase in relative humidity lower the average number of people a sick person continues to infect (in a group that has no immunity to the virus) by 2.5% and 1.58% respectively.

Similarly, Mahmoud Arbouch and Uri Dadush (2020)[22] of the Policy Centre for the New South estimate that a 1% increase in temperature above average levels (50 degrees Fahrenheit, or 10 degrees Celsius) could reduce the number of cases per million people by 0.5% (with a margin of error of +/- 0.2%). They also find that the incidence of the disease could be lower in very cold weather.

Xie J. et al. (2020)[23] have collected daily confirmed cases and meteorological factors in 122 cities between January 23, 2020, to February 29, 2020. A generalised additive model (GAM) was applied to explore the nonlinear relationship between mean temperature and COVID-19 confirmed cases. They also used a piecewise linear regression to determine the relationship in detail. They found that "*mean temperature has a positive linear relationship with the number of COVID-19 cases with a threshold of 3 °C. There is no evidence supporting that case counts of COVID-19 could decline when the weather becomes warmer*"

Table 1 below provides a summary of the findings of the studies presented in this section.

[19] Platteau, J-P and V Verardi (2020), "How To Exit Covid-19 Lockdowns: Social Structure Matters", mineo, Centre for Research in Economic Development (CRED), University of Namur.

[20] Gaye b. Et al. (2020) "socio-demographic and epidemiological consideration of Africa's COVID-19 response: what is the possible pandemic course?", *nature medicine*, *26*(7). Https://doi.org/10.1038/s41591-020-0960-y

[21] Wang.J, Tang.K, Feng.K, et Lv.W (2020), "High Temperature and High Humidity Reduce

[22] Mahmoud Arbouch et Uri Dadush (2020), "Coronavirus and Temperature", Policy Centre for new South, 20-21 MarCH 2020

[23] Xie J, Zhu Y. Association between ambient temperature and COVID-19 infection in 122 cities from China. *Sci Total Environ*. 2020;724:138201. doi:10.1016/j.scitotenv.2020.138201

Table 1: Synthesis of possible impact of structural factors on COVID-19 infections and deaths

POTENTIAL STRUCTURAL FACTORS	PAPERS	FINDINGS	COMMENTS
The intrinsic quality of the health system	*Wong et al. (2020)"Is the Global Health Security (GHS) Index a Significant Factor Associated with COVID-19 Control? A Country Level Analysis"*	The GHS index was found to be a significant predictor of COVID-19 pandemic control.	Controversial effect on COVID-19 severity (infections and deaths)
	Kushan T. et al (2020) « The impact of temperature, population size and median age on COVID-19 (SARS-CoV-2) outbreak"	*There is no evidence supporting that case counts of COVID-19 could decline in countries with better health care facilities.*	
Population density	Bhadra, A. et al. (2020) "Impact of population density on COVID-19 infected and mortality rate in India"	After a detailed correlation and regression analysis of infection and mortality rates due to COVID-19 at the district level (in India), a moderate association between COVID-19 spread and population density is found.	Controversial effect on COVID-19 severity (infections and deaths)
	Vishalkumar J. et al (2020) "COVID-19 and Socioeconomic Factors: Cross-country Evidence"	*The population density does not have significant impact. The countries with higher population density have lower deaths."*	
Age	Vishalkumar J. et al (2020) "COVID-19 and Socioeconomic Factors: Cross-country Evidence"	The median age does not have significant impact.	Controversial effect on COVID-19 severity (infections and deaths)
		Deaths are highly concentrated in the older population (65 and over).	
Gender	Ciminelli, G, and S Garcia-Mandicó (2020), "COVID-19 in Italy: an Analysis of Death Registry Data"	Mortality increases exponentially with age, but at much higher levels for men: the effects of COVID-19 for men are three times those for women.	Further studies needed
Weight	Fakhry A. et al. "Obese communities among the best predictors of COVID-19-related deaths."	BMI per country proved to be the second-best predictor of death rate with an R value of 0.43, and GDP being the best predictor with R = 0.65.	Further studies needed
	Mahmoud Arbouch et Uri Dadush (2020), "Coronavirus and Temperature"	1% increase in temperature above average levels (50 degrees Fahrenheit, or 10 degrees Celsius) could reduce the number of cases per million people by 0.5% (with a margin of error of +/- 0.2%).	Controversial effect on COVID-19 severity (infections and deaths)

Temperature	Xie J. et al. "Association between ambient temperature and COVID-19 infection in 122 cities from China"	Mean temperature has a positive linear relationship with the number of COVID-19 cases with a threshold of 3 °C. There is no evidence supporting that case counts of COVID-19 could decline when the weather becomes warmer.	
Blood group	Zhao Jiao and Al. (2020), " Relations between the ABO Blood Group and the COVID-19 susceptibility	"Blood group A is associated with a higher risk of contracting COVID-19 compared to other blood groups, while blood group O is associated with a lower risk".	Further studies needed
Chronical diseases	Flaherty, G. et al. "COVID-19 in adult patients with pre-existing chronic cardiac, respiratory and metabolic disease: a critical literature review with clinical recommendations"	Deaths are highly concentrated in the older population (65 and over) and amongst people with severe pre-existing diseases, according to a study by Chinese researchers.	Further studies needed

Table 1: Synthesis of possible impact of structural factors on COVID-19 infections and deaths (following)

POTENTIAL STRUCTURAL FACTORS	PAPERS	FINDINGS	COMMENTS
The country's exposure to malaria and the vaccination of children with BCG	Raham T. F. (2020), "Malaria Endemicity Influence on COVID -19 Mortality: New Evidence Added to BCG and TB Prevalence	Standardised TB prevalence to BCG coverage is significantly associated with reduced COVID-19 mortality and malaria incidence have an additional highly significant effect in reducing COVID-19 mortality".	Controversial effect on COVID-19 severity (infections and deaths)
	Muneer A. and Al (2020), "Comparative analyses revealed reduced spread of COVID-19 in malaria endemic countries"	The malaria free countries not only have higher density of COVID-19 infections but also higher case fatality rates as compared to highly malaria endemic countries".	
	Miller et al. (2020) "Correlation between universal BCG vaccination policy and reduced morbidity and mortality for COVID-19: an epidemiological study	Countries without universal policies of BCG vaccination have been more severely affected compared to countries with universal and long-standing BCG policies. Difference cannot be accounted for by differences in disease onset, adoption of early social distancing policies, state of health services, nor income level.	
	Li et al. (2020) "The Correlation between BCG Immunisation Coverage and the Severity of COVID-19"	BCG vaccination policies' correlation with the morbidity and mortality for COVID is not significant in general. It is only marginally significant amongst countries with BCG when median age is also considered.	

The national culture	Platteau, J-P and V Verardi (2020), "How To Exit COVID-19 Lockdowns: Social Structure Matters"	"The measures Belgium would need to take when re-opening its economy would be more moderate if it had the same interaction patterns as Germany and more strict if it had Italy's interaction patterns".	Further studies needed
Lessons from past epidemics outbreaks	Gaye B. Et al. (2020) "Socio-demographic and epidemiological consideration of Africa's COVID-19 response: what is the possible pandemic course.	The experience of tackling other epidemics (like Ebola) has helped African countries cope with the pandemic relatively well so far.	Further studies needed

Intrinsic quality of pandemic governance

COVID-19 has elicited a wide range of responses from governments around the world. In addition, governments have varied considerably in the measures they have taken and the speed with which they have adopted them. In the following lines, we review the main COVID-19 policy responses that have been adopted in the world.

Global Resilience Strategy: Mitigation/Suppression

The Imperial College of London Report (2020)[24] on the impact of an uncontrolled pandemic describes two main approaches available to contain COVID-19. The first is ***mitigation***: slowing the spread of the epidemic but not completely interrupting transmission, whilst ensuring that the health needs of those at risk of developing severe forms of infection are met. It aims at achieving "herd immunity" against the virus in the population. However, "herd immunity" is theoretically only conceivable in countries with sufficiently developed hospital capacities that are capable of absorbing a large flow of patients. The United Kingdom initially opted for this strategy but changed its mind, in view of the rapid spread of the virus and growing social protest.

According to the authors, this approach is unlikely to contain the pandemic and may lead to the death of thousands of patients, whilst placing a heavy burden on health systems, especially the available intensive care units.

Researchers recommend the second approach, ***suppression***. It refers to reversing the spread of the epidemic by reducing the rate of coronavirus infection and maintaining this approach for up to eighteen (18) months. Spread reversal can be achieved through the implementation of non-pharmaceutical interventions. These include strict lockdown measures - social distancing of entire populations, closure of schools and community spaces - and extension of these measures until vaccines can be developed. This is the approach taken by many countries around the world.

Screening strategy (selective versus broad-based screening)

Some countries (South Korea, Germany or Australia), in line with WHO recommendations, have launched massive population screening campaigns at an early or earlier stage, whilst other countries (France, Tunisia, Senegal) have chosen to limit testing to a segment of the population (generally people with symptoms or who have been in contact with confirmed cases of COVID-19).

The Cochrane Library[25] assessed two modelling studies that reported on the effectiveness of universal screening, as well as 20 studies (17 cohort studies, three modelling studies) that reported on screening test accuracy. The studies were conducted in the US, Europe and Asia. Weak evidence in favour of screening is reported.

[24]Neil M Ferguson, Daniel Laydon et Al. (2020), "Impact of non-pharmaceutical interventions (NPIs) to reduce COVID19 mortality and healthcare demand", Centre for Infectious Disease Modelling, Centre for Global Infectious Disease Analysis, 16 Mars 2020.

[25] Viswanathan M, et al. (2020) "Universal screening for SARS-CoV-2 infection: a rapid review". Cochrane Database Syst Rev 2020 (rapid version published 15 Sep). doi:10.1002/14651858.CD013718.

Containment policies

Hsiang et al. (2020)[26] estimate the effect of containment measures on the growth rate of infection using data on 1,717 local, regional and national non-pharmaceutical interventions deployed in China, Korea, Italy, Iran, France and the United States. They estimate that, in the absence of policy actions, early infections of COVID-19 exhibit exponential growth of roughly 38 percent per day and find that anti-contagion policies have significantly reduced this growth.

Tian et al. (2020)[27] estimate the role of the Wuhan travel ban and public health non-pharmaceutical
interventions (NPI) in China on the reproduction number ($R0$) of COVID-19, using a geocoded repository of COVID-19 data. They find that the reproduction number fell significantly after travel restrictions were implemented.

The Model

This part is the heart of the study. Its main objective is to identify, in a robust way, the factors - both structural and related to the response to COVID-19 - that explain the countries' differences in performance in the severity index. For this, the following approach is adopted: first, we use the review of the literature, presented above, to collect data on structural factors and policy response to COVID-19. We then conduct a series of univariate analyses to gain a first glimpse of the relationship between these factors and the severity index. Finally, we conduct multivariate analyses to find causal relationships between potential factors of resilience and performance in the severity index. In parallel, we carry out several robustness analyses by changing the data structure (panel vs cross-sectional data) and / or the specification of the regression models.

The approach adopted is doubly innovative: first, we identify in the same framework the impact of policy response to COVID-19 and structural factors. Second, our variable of interest or dependent variable is a synthetic index which aggregates the several dimensions of the disease (cumulative cases, new cases, cumulative deaths, cures).

[26] Hsiang, S. et al.(2020)"The effect of large-scale anticontagion policies on the COVID-19 pandemic". Nature, pp.1-9.

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Data

We collect policy responses to COVID-19 indicators (or policy indicators) and structural variables from 147 countries spread over five continents.

The structural variables are 16 in number and come from the World Bank (Word Development Indicators (WDI) database) and WHO (BCG immunisation coverage data). The selection of structural variables is based on the above literature review and the availability of data. Some of the structural indicators (life expectancy at birth, GDP per capita, continent) are not considered, as such, as potential factors but are added to serve as control variables.

Table 2: List of structural variables

Variables	Comments	Source
Incidence of malaria	(per 1,000 population at risk)	WDI
International tourism, number of arrivals		WDI
Life expectancy at birth	total (years)	WDI
Mortality from CVD	cancer, diabetes or CRD between exact ages 30 and 70 (%)	WDI
Population ages 65 and above	(% of total population)	WDI
Population density	(people per sq. km of land area)	WDI
Hospital beds	(per 1,000 people)	WDI
GDP per capita	(current US$)	WDI
Incidence of tuberculosis	(per 1,000 people)	WDI
Nurses and midwives	(per 1,000 people)	WDI
Physicians	(per 1,000 people)	WDI
Median age		UN
bcg2000	BCG Immunisation coverage estimates in 2000	WHO
bcg1990	BCG Immunisation coverage estimates in 1990	WHO
bcg1980	BCG Immunisation coverage estimates in 1980	WHO
Temperature	average from January to September	World Bank
Continent		

Government response to COVID-19 indicators (or policy indicators) are collected from the Oxford database (OxCGRT) which collects publicly available information on 18 COVID-19 management indicators by 180 governments around the world (see Box 1). We consider the eight indicators (C1-C8) which record information on containment measures, such as school closures and movement restrictions, the indicator on test policy (which we denote by "test"), the indicator on the contact tracing policy (which we denote by “contact”) and the aggregate index (the COVID-19 government response stringency index) which we denote by C0. These variables are collected over the period from April 18 to September 27.

Box 1: **The Oxford Covid-19 Government Response Tracker (OxCGRT)**

The Oxford COVID-19 Government Response Tracker (OxCGRT) systematically collects information on several different common policy responses that governments have taken, records these policies on a scale to reflect the extent of government action and aggregates these scores into a suite of policy indices. Eight of the policy indicators (C1-C8) record information on containment and closure policies, such as school closures and restrictions in movement. Four of the indicators (E1-E4) record economic policies, such as income support to citizens or provision of foreign aid. And six indicators (H1-H6) record health system policies such as the COVID-19 testing regime or emergency investments into healthcare. The policy indicators are recorded on an ordinal scale.

The COVID-19 ***government response stringency index*** *aggregates all C indicators, plus H1 which records public information campaigns, into a single number. This composite measure is a simple additive score of the policy indicators measured on an ordinal scale, rescaled to vary from 0 to 100.*

From these policy indicators, which are ordinal scores that change over time, for each country we want to measure three associated phenomena (dimensions). For each policy (C0 to C8, test, contact): (i) how quickly it was implemented, (ii) at which stringency it was introduced for the first time; (iii) what is the highest stringency level it reached from April to September 2020. In order to measure those three dimensions, we derive from each policy variable (C0 to C8, test and contact) new policy indicators as follows:
Let Var_i be a policy variable in the list (C0 to C8, test, contact). Let k be an integer which varies between 2 and 4 depending on the number of modalities of Var_i. We associate k thresholds (threshold_j, j varying from 1 to k) to Var_i (see table 3).We define :

- rj_Var_i: the number of days between the first case of infection and the date where the score in Var_i is equal or higher than threshold_j. These indicators measure the speed with which the policy Var_i is introduced into the country.

- d_Var_i : the score in Var_i at the date of introduction of Var_i. This variable measures the level of stringency of Var_i when it was first introduced in the country.
- score_max_Var_i: the maximum score in Var_i between April and September 2020.

In total, we construct 54 other policy indicators from the list of the 11 selected Oxford policy variables (C0 to C8, test contact). The policy indicators which, therefore, add up to 65 in number, are grouped into four categories (see table 4): "***speed of introduction***" (the r_j_Var_ i indicators), "***stringency at introduction***" (the d_var_i indicators), "***maximum stringency***" (the score_max_var_i indicators) and "***contemporary stringency***" (C0 to C8, test, contact).

The variable of interest is the score in the severity index calculated on a weekly basis every Monday morning, between April 18 and September 27. Thus, we have a cylinder panel of 3624 observations.

Table 3: Thresholds associated with the Oxford policy indicators[28]

Selected Oxford policy indicators	Description	threshold 1	threshold 2	threshold 3	threshold 4
C0	COVID-19 government response stringency index	0	10	20	30
C1	School closing	0	1	2	
C2	Workplace closing	0	1	2	
C3	Cancel public events	0	1		3
C4	Restrictions on gathering size	0	1	2	
C5	Close public transport	0	1		
C6	Stay at home requirements	0	1	2	
C7	Restrictions on internal movement	0	1		
C8	Restrictions on international travel	0	1	2	3
Test	Testing policy	0	1	2	
Contact	Contact tracing	0	1		

Table 4 : Categorisation of the policy indicators

Policy indicators category	Indicators	Number of indicators
Contemporary stringency	11 selected Oxford policy indicators: (C0 to C8, test, contact)	11
Speed of introduction	rj_var_i indicators , var_i among (C0 to C8, test, contact)	32
Stringency at introduction	d_var_i indicators, var_i among (C0 to C8, test, contact)	11
Maximum stringency	score_max_var_i , var_i among (C0 to C8, test, contact)	11

[28] Indicators C1 to C8 are ordinal variables with 3 or 4 categories (0, 1, 2,3). We consider each modality as a threshold

Methodology and results

In this part, we build several regression models of the severity index on the explanatory variables (multivariate analyses) described in the previous section, using both panel data and cross-sectional data. The objective is to identify the potential factors of resilience that explain, in a robust way, the differences in performance between countries measured by the COVID-19 severity index. Before carrying out these multivariate analyses, we conduct univariate analyses which will offer a first overview of the links between potential resilience factors and performance in the severity index.

UNIVARIATE ANALYSIS

We carry out the univariate analysis by calculating, on the one hand, the two-by-two correlations between each explanatory variable and the severity index variable and, on the other hand, by identifying the variables that are robustly associated with the "very low severity" class.

Without establishing causal relationships, they will provide a first overview of the links between potential resilience factors and performance in the severity index. For this, we first work with the panel data and the scores in the severity index and calculate the two-by-two correlations between each explanatory variable and the variable of interest (which is the severity index). Second, we work with cross-sectional data and severity classes derived from the severity index, in order to identify the potential resilience factors that characterise the best performing severity class.

CORRELATION CALCULATIONS IN THE PANEL DATA

We calculate on the panel sample, the correlations between each of the explanatory variables (except those in the “maximum stringency” category) and the severity index. Table 9 in the annexes reports the explanatory variables in each category, which are significantly correlated (at the 5% level) with the severity index over the period of the study. The pairwise correlations are all relatively weak and vary between 4% and 11% in absolute value.

Amongst the structural variables, the GDP per capita (correlation value: 7%), the incidence of tuberculosis (11%) and the BCG vaccination coverage in 1980 are positively correlated with the severity index, whilst the number of physicians (per 1000 inhabitants) (-5%), the number of deaths induced by cardiovascular diseases (diabetes and cancer (-9%) and BCG vaccination coverage in 2000 (-8%) are negatively correlated with the severity index.
In the “speed of implementation” category, the indicators associated with C3 and C4 are negatively correlated with the severity index, whilst those related to C0, C5, C6 contact and test are positively correlated with the severity index. Amongst the indicators of the “stringency at introduction” category, those associated with C5 and contact are negatively correlated with the severity index, whilst those associated with C7 and C2 are positively correlated with the severity index. In the “contemporary stringency” category, test and C7 are positively correlated with the severity index, whilst C5 is negatively correlated with the index.

2. "VERY LOW SEVERITY" CLASS CHARACTERISATION

Performing countries characterisation analysis in the panel sample

In this section, we identify the variables that significantly distinguish the class of countries with very low severity (score in the severity index greater than or equal to 0.9 at date t). For this, we use the statistic of the test value[29].

Table 10 in the annexes displays the variables that significantly characterise (absolute value of the test value greater than 2) the "very low severity" class (corresponding to a score in the severity index greater than or equal to 0.9).

Table 10 shows that, with the exception of two indicators (test and contact), policy indicators of the "contemporary stringency" category all display a negative test value. In other words, countries with very low severity are, on average, characterised by lower levels of containment measure stringency than the other countries in the sample. This is easily understood if we consider that it is the countries hardest hit by the pandemic that have implemented the containment policies to their highest stringency level. The same phenomenon is observed when we consider the speed of implementation. With the exception of the same two measures (test and contact), the performing countries have taken a longer time (relative to the date of the first Covid case) to implement containment polices and to exceed the stringency thresholds associated with each of them. Regarding the containment policies stringency at the first day of implementation, countries with very low severity are significantly characterised by higher levels for the policies C0 test, C8 and contact, whilst they are significantly characterised by lower levels for policies C5, C6 and C7.
As for the structural variables, performance in the severity index is associated with higher incidence of malaria, higher numbers of nurses, hospital beds, a higher proportion of people over 65, a lower incidence of tuberculosis and a lower number of incoming tourists.

Robustness analyses: performing countries characterisation on cross-sectional data

In the previous section, the characterisation analysis was done with the panel data. However, the performing class does not contain the same countries at different dates. In this section, we eliminate the temporal dimension and carry out the same characterisation exercise on cross sectional data. To do that, we consider for each country the following five (5) indicators, which are all variants of the severity measurement:

- **Score_min:** the minimum score in the index over the period

[29] The test value can be read like the statistic of a test of comparison of means where, under the null hypothesis of equality of means, it would asymptotically follow the standard normal distribution. For the usual risk level (5%), the means difference is significant when the absolute value of the test value is greater than 2. If the test value is positive (resp. negative), the class is characterised by the strong (resp. weak) values of the variable.

- **Score_avg**: the average score in the index over the period
- **Score_wght**: the weighted score in the index (increasing weightings over time)
- **Score_pic:** the score of the country at the week of the peak (date when the number of new cases reaches its maximum over the period)
- **Score_last:** the country's score as of September 27 (corresponding to the last observation date)

The construction of these variants of severity measurement is based on the idea that a resilient country to COVID-19 has maintained a high score in the index throughout the period from April to September or has progressively achieved a high score in the index through the effective implementation of containment measures.

Due to the elimination of the time dimension, indicators of the "contemporary stringency" and the "maximum stringency" categories are removed from the cross-sectional sample. The number of observations in the cross-sectional sample is 147, corresponding to the number of countries.

Table 5 displays for each performance criteria, the variables and the test values associated with them that significantly distinguish the best performing class (only variables that are significant in at least 3 regressions out of 5 are displayed, see table 11 in the annexes for the full list of significant variables). For all the severity measurement variants, the variables in the "maximum stringency" category display negative test values, except the indicator associated with the testing policy. Likewise, the test values of the indicators in the "speed of introduction" category are all positive. These findings are in line with the results of the correlations analysis, mentioned above. Compared to the other countries in the sample, very low severity countries introduced containment measures later (relative to the date of the first case in the country) and at lower maximum stringency during the period from April to September. However, the testing policy reached its maximum stringency level sooner in the performing countries (for 3 out of 5 performance criteria). Regarding the indicators of the "stringency at introduction" category that associated with the aggregate Oxford stringency index, (C0) is the only one to be significant across several severity measurement variants (4 out of 5) with a positive test value. In other words, the performing countries have introduced the comprehensive containment measures at higher stringency levels. As for structural variables, they are significant only twice out of five at most.

Table 5: Variables characterising the "very low severity" class in the cross-sectional sample and their test value, according to the severity measurement variant[30]

Indicator	Category	Dependent variable				
		Score_avg	Score_pic	Score_wght	Score_last	Score_min
d_1co	**Stringency at introduction**	3.1	2.0	2.4		2.5
score_maxc6	**Maximum stringency**	- 3.0		- 2.7		- 2.0
score_maxtest	**Maximum stringency**	2.6		2.1		2.1
r_1	**Speed of introduction**	2.9	2.2			3.0
r_1_C8	**Speed of introduction**	2.3	2.2			2.5
r_3_C1	**Speed of introduction**	2.0		2.0		2.2
r2_C6	**Speed of introduction**	3.0		3.3		2.8
r2_C7	**Speed of introduction**	2.7		2.9		3.1
r3_C4	**Speed of introduction**	2.0		2.4		2.1
r4_C4	**Speed of introduction**	3.1	2.7	3.8		2.4

3. SUMMARY OF THE UNIVARIATE ANALYSIS FINDINGS

Overall, the various univariate analyses revealed the following findings in a robust manner:
• Performing countries introduced comprehensive restrictive containment measures at higher levels at the start of their implementation.
• Performing countries had higher contemporary and maximum stringency levels in their testing policy during the period from April to September.
• Compared to other countries, "very low severity" countries implemented restriction measures later (relative to the date of the country's 1st case) and at lower contemporary stringency levels during the period from April to September.

These findings allow associations to be established between certain explanatory variables and performance in the severity index. However, they say nothing about the existence of causation. Moreover, they say nothing about the role of structural variables. For all these reasons, we deepen the analysis by conducting multivariate analyses.

[30] **Only variables that are significant in at least 3 regressions out of 5 are displayed. See table in the appendix for the full list of significant variables**

MULTIVARIATE ANALYSIS

Unlike univariate analyses, the analyses in this section will provide explanations for the differences in resilience and performance in the severity index. We build several regression models of the severity index on the explanatory variables (multivariate analyses). First, we regress the severity index on the explanatory variables using panel data. Secondly, several robustness analyses are carried out through regressions of the severity index using cross-sectional data.

Before carrying out these analyses, given that we are faced with a relatively large number of explanatory variables, we carry out multicollinearity tests to retain only the variables with a sufficiently low multicollinearity.

- Multicollinearity analysis

We rely on what are called variance inflation factors (VIF)[31] to help detect multicollinearity. In order to select a set of variables with sufficient low multicollinearity, we implement a stepwise selection by starting with the variable having the largest VIF. This is done by computing the VIF values for the full set of explanatory variables, after which the variable with the highest VIF is removed. Next, the VIF values are computed again for the reduced set of variables. This is repeated until the largest VIF is smaller than a VIF threshold value (set to 10).

After this operation, we retained 58 explanatory variables from the initial list of 81 indicators (16 structural variables and 65 policy variables). The explanatory variables retained for the multivariate analyses are presented in the annexes (table 12).

1. Panel regression of the severity index

In this section, we perform a pooled panel regression of the severity index on the explanatory variables. All the variables, except GDP per capita and life expectancy at birth, which we consider as control variables, are potential resilience factors. Here, we add the continent as a variable to the list of explanatory variables of the regression. Table 13 in the annexes displays the results of the panel regression. Amongst the variables of the “stringency at introduction” category, only the indicators d_C0, d_C4 and d_C5, which are respectively associated with the overall stringency index C0, policy C4 and policy C5, have significant positive coefficients. In the “contemporary stringency” category, only the indicator associated with the contact tracing policy (contact) significantly and positively affects the severity index - all things being equal. Amongst the indicators in the “speed of introduction” category, only those associated with the testing policy (r_1_test, r_2_test and r_3_test) emerge as having a

[31] VIF score of an independent variable represents how well the variable is explained by other independent variables. A VIF for a single explanatory variable is the reciprocal of the inverse of the coefficient of determination from the regression of that variable against all other explanatory variables:

significant positive impact (negative regression coefficient) on the severity index. Amongst the structural factors, only the coefficient of the average temperature is not significant.

We perform the following panel regression

$$\mathbf{Score}_{i,t} = \boldsymbol{a} + \sum_j \mathbf{a}_j * \mathbf{pol\_var(j)}_{i,t} + \sum \mathbf{b}_m * \mathbf{struc\_}\boldsymbol{var}(\boldsymbol{m})_{\mathbf{i}} + \mathbf{e}_{i,t}$$

Where:

- $\mathbf{Score}_{i,t}$ **: country i score in the severity index at date t**
- **pol_var (j)** $_{i,t}$: ***country i score at date t in*** **the jth** ***policy indicator***
- **struc_*var*(*m*)** $_{\mathbf{i}}$: country i score in the mth structural indicator

2. Robustness analysis: Regressions on cross-sectional data

As with the univariate analysis, we test the robustness of the results of the multivariate analysis by performing several regressions on cross-sectional data which, thus, ignore the time dimension. To be explained, these regressions have the same explanatory variables and differ by their variable. We consider the 5 severity variants introduced in the second part of the univariate analysis and regress each of them on the explanatory variables. As with the univariate analysis, given that the time dimension is absent in these regressions, the indicators of the “contemporary stringency” and the “maximum stringency” categories are not included. The number of observations for each regression is 147, corresponding to the number of countries in the sample.

For each variant j (j=1 to 5) of the severity measurement we perform the following regression[32]

$$\mathbf{Score(j)}_i = \boldsymbol{a}(\boldsymbol{j}) + \sum_k \mathbf{a}_k \ (\mathbf{j}) * \mathbf{pol\_var(k)}_i + \sum \mathbf{b}_m \ (\mathbf{j}) * \mathbf{struc\_}\boldsymbol{var}_{\mathbf{m}} + \mathbf{e}_i$$

Where:

- $\mathbf{Score(j)}_{\mathbf{i}}$ **: country i score in the jth variant of severity measurement**
- **pol_var (k)** $_i$: ***country i score in*** **the kth** ***policy indicator***
- **struc_*var*(*m*)** $_{\mathbf{i}}$: country i score in the mth structural indicator

Table 6 displays the significant coefficients for each of the five regressions (only significant variables in at least 3 out of 5 regressions with a coefficient keeping the same sign are displayed. See table 14 in the appendix for the full list of significant variables**).** Amongst the indicators of the “stringency at introduction” category, only d_C0 which is associated with the aggregate stringency index (C0), displays a significant coefficient in three

[32] With 147 observations, the number of regressors is high. They are not all introduced at the same time. We used stepwise regressions to arrive at the best model with only significant variables.

out of 5 regressions, with a positive coefficient each time. For the indicators of the "speed of introduction" category, no variable exhibits a significant coefficient in at least three of the 5 regressions with a positive impact (negative coefficient).Amongst structural indicators, the incidence of malaria (negative coefficient), population density (negative coefficient) and the continent show significant coefficients in at least three out of five regressions.

Table 6: Variables with significant coefficient in the cross-sectional regressions[33]

		Dependent variable in the regression				
Category	**Variable**	**Score_last**	**Score_min**	**Score_wght**	**Score_pic**	**Score_avg**
Stringency at introduction	**d_co**	4.61E-03	5.46E-03	4.75E-03		5.23E-03
	d_c1	3.58E-02				
	d_c7	4.37E-02	-3.86E-02			
	d_c8	-2.31E-02				-1.51E-02
Speed of introduction	r_1_c2	-7.20E-04		4.04E-04		
	r_1_C6	4.76E-04				3.31E-04
	r_2_test	-2.56E-04				
	r_2_c2	5.61E-04				
	r_1_c7	6.72E-04				
Structural	log (GDP)	-5.51E-02				
	Incidence of malaria (per 1,000 population at risk)		2.69E-04	2.33E-04		1.78E-04
	Incidence of tuberculosis (per 100,000 people)			-1.60E-04		-1.84E-04
	Population density		-4.90E-05		-4.65E-05	-1.91E-05
	Population ages 65 and above (% of total population)				9.80E-03	6.07E-03
	Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 (%)			4.08E-03		
	Continent -Africa	-1.58E-01	-1.76E-01			-8.08E-02
	Continent -America	-2.01E-01	-2.19E-01	-1.36E-01	-1.25E-01	-1.72E-01
	Continent -Asia	-1.40E-01	-1.07E-01		-1.83E-02	-5.84E-02
	Continent -Europe	-2.24E-01	-2.28E-01	-1.47E-01		-1.71E-01

[33] Only significant variables in at least 3 out of 5 regressions with a coefficient keeping the same sign are displayed. See table in the appendix for the full list of significant variables

3. Summary of the multivariate analysis findings

The results of the panel regression and those of the cross-sectional regressions make it possible to identify, in table 7 below, the variables that stand out in a robust way as an explanatory factor of resilience to COVID-19.

Table 7: Final list of indicators that robustly explain country resilience to COVID-19

Category	Indicator	Description
Stringency at introduction	**d_C0**	**Score in the Oxford aggregate stringency (C0) at day of introduction), C0 >0)**
Speed at introduction	**r__3_C0**	**Number of days between the first Covid case and the day where C0 hits the thresold 20**
Structural	**Incidence of malaria**	**(per 1,000 population at risk)**
	Population density	**(people per sq. km of land area)**
	Continent	

The countries most affected by the pandemic, i.e., the worst performing countries in terms of score, have implemented restriction measures at higher levels, but too late. These countries have tended to wait for the disease to reach certain proportions before reacting strongly. However, countries which from the start, without waiting for the disease to reach certain proportions,took relatively tough measures, had better control of the disease, which enabled them not to resort thereafter, for an extended period of time, to harsher restriction levels introduced elsewhere.

CONCLUSIONS AND RECOMMENDATIONS

Implementation of comprehensive containment policies at high levels of stringency upon their introduction explain resilience to COVID-19 - all other things being equal. Thus, ***taking restrictive measures with a broad perameter and at a strong level of stringency, very early in the fight against the pandemic, is preferable*** to the following two options: (i) a strategy which would consist of localising the restrictions, even at a very strong level of stringency only for certain areas and (ii) a strategy which consists of adjusting the level of restrictions, even with broad parameters to the evolution of the pandemic.

Thus, rapid introduction of comprehensive containment measures at high levels of stringency improves resilience to COVID-19. After the introduction of general containment measures, it is better to tighten the restrictions to significantly higher levels of stringency, in the event of an unfavourable course of the disease, rather than betting on a gradual improvement over time.

Furthermore, structural factors such as low population density, incidence of malaria and the continent explain resilience to COVID-19. All other things being equal, countries with a low population density are more resilient to COVID-19. Likewise, all other things being equal, the countries most exposed to malaria develop better resilience to COVID-19. The significant effect of the continent indicates that none of the structural variables considered in the Model developed are sufficient to explain the impact of geography on resilience. The significant effect of the continent could reflect the effect of another factor not considered in this study and correlated to geography.

Once these factors are taken into account, cross-country differences in median age, temperature and BCG vaccination coverage do not explain cross-country difference in resilience to COVID-19. Indeed, the impact of these factors fades as soon as you take into account the continent, the incidence of malaria and the density of the population. In other words, as an example, the effect of the median age variable on the country's resilience is more a reflection of the three significant structural factors mentioned above to which it is correlated.

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ANNEXES

Table 8: COVID-19 severity index scores as of September 27, 2020

Country	score as of 27/09/2020	Rank
Cambodia	1.00	1
Ghana	1.00	2
New_Zealand	0.99	3
Mongolia	0.99	4
South_Sudan	0.99	5
Brunei_Darussalam	0.99	6
Sri_Lanka	0.99	7
Singapore	0.99	8
Ivory Coast	0.99	9
Seychelles	0.99	10
Guinea	0.99	11
Democratic_Republic_of_the_Congo	0.99	12
Zambia	0.98	13
Mauritania	0.98	14
Thailand	0.98	15
Japan	0.98	16
Niger	0.98	17
Cuba	0.98	18
Vietnam	0.97	19
Liberia	0.97	20
Benin	0.97	21
Azerbaijan	0.97	22
Australia	0.97	23
Nigeria	0.97	24
Pakistan	0.96	25
Burundi	0.96	26
Egypt	0.96	27
Serbia	0.96	28
Fiji	0.95	29
Dominica	0.95	30
Cameroon	0.95	31
Afghanistan	0.95	32
Bhutan	0.95	33
Uzbekistan	0.95	34
Congo	0.93	35
Saudi_Arabia	0.93	36
Gabon	0.93	37

Senegal	0.93	38
Malawi	0.93	39
Poland	0.93	40
Haiti	.,92	41
Kyrgyzstan	0.92	42
Guatemala	0.92	43
Venezuela	0.92	44
Togo	0.92	45
Madagascar	0.92	46
Germany	0.91	47
Croatia	0.91	48
Rwanda	0.91	49
Mali	0.91	50
Kenya	0.90	51
Philippines	0.90	52
Chile	0.90	53
Uruguay	0.90	54
Nepal	0.89	55
Greece	0.89	56
Canada	0.89	57
Latvia	0.89	58
Indonesia	0.89	59
China	0.88	60
Bangladesh	0.88	61
Zimbabwe	0.88	62
Turkey	0.88	63
Belarus	0.87	64
Qatar	0.87	65
Morocco	0.87	66
United_Republic_of_Tanzania	0.87	67
Djibouti	0.87	68
Iran	0.86	69
India	0.86	70
Norway	0.86	71
Chad	0.86	72
Namibia	0.85	73
Finland	0.85	74
Malaysia	0.85	75
Romania	0.85	76
Cyprus	0.85	77
Cape_Verde	0.85	78
Estonia	0.84	79
Mauritius	0.84	80

Gambia	0.84	81
Eritrea	0.83	82
Algeria	0.83	83
Bulgaria	0.81	84
Sierra_Leone	0.81	85
Kuwait	0.81	86
Iceland	0.81	87
United_Arab_Emirates	0.81	88
Mozambique	0.81	89
Yemen	0.80	90
Colombia	0.80	91
Brazil	0.80	92
Jordan	0.80	93
Albania	0.80	94
Russia	0.79	95
Peru	0.79	96
Iraq	0.79	97
Switzerland	0.79	98
Panama	0.79	99
Dominican_Republic	0.79	100
Argentina	0.78	101
Mexico	0.78	102
Burkina_Faso	0.78	103
Slovenia	0.78	104
Moldova	0.77	105
Denmark	0.77	106
Ethiopia	0.77	107
Uganda	0.77	108
Bolivia	0.76	109
United_States_of_America	0.76	110
Libya	0.76	111
Oman	0.75	112
Bahrain	0.75	113
Belize	0.75	114
Luxembourg	0.75	115
Austria	0.74	116
Lithuania	0.74	117
Bosnia_and_Herzegovina	0.74	118
Slovakia	0.72	119
Guyana	0.72	120
Italy	0.72	121
Israel	0.71	122
Sudan	0.70	123

Honduras	0.69	124
Kazakhstan	0.69	125
Angola	0.68	126
Nicaragua	0.68	127
Ecuador	0.68	128
Paraguay	0.67	129
Lebanon	0.66	130
Myanmar	0.66	131
Georgia	0.64	132
Central_African_Republic	0.64	133
Portugal	0.63	134
Chechyna	0.60	135
Ukraine	0.60	136
Botswana	0.58	137
Ireland	0.57	138
Costa_Rica	0.57	139
Tunisia	0.56	140
South_Korea	0.56	141
Jamaica	0.54	142
South_Africa	0.47	143
Spain	0.47	144
France	0.46	145
Belgium	0.45	146
Hungary	0.44	147

Table 9: Significant correlations between the explanatory variables and the severity index

Stringency at introduction		Contemporary stringency		Speed of introduction		Structural indicators	
Indicator	Correlation value	Indicator	Correlation value	Indicator	Correlation value	Indicator	Correlation value
d_1c2	7%	test	4%	r_2_C5	11%	Incidence of tuberculosis	11%
d_1c7	7%	c5	-5%	r2_C6	10%	bcg1980	9%
d_1_contact	-4%	c7	4%	r_1C5	8%	GDP per capita	7%
d_1c5	-11%			r_1_test	8%	Physicians (per 1,000 people)	-5%
				r3_c2	6%	bcg2000	-8%
				r_1C6	6%	Mortality from CVD	-9%
				r_3C6	6%		
				r_2_contact	6%		
				r_1_C0	5%		
				r_1c2	5%		
				r_3_C1	-4%		
				r_3_C0	-4%		
				r_4_C0	-4%		
				r_1c3	-5%		
				r3_C4	-5%		
				r2_C4	-6%		
				r1_C4	-8%		
				r3_C8	-8%		

Table 10: Full list of variables characterising the "very low severity" class in the panel sample

Stringency at introduction		Contemporary stringency		Speed of introduction		Structural factors	
Indicator	**v-test**	**indicator**	**v-test**	**indicator**	**v-test**	**indicator**	**v-test**
d_1_C0	9.,1	contact	5.8	r4_C4	8.2	Incidence of malaria	4.3
d_1_test	4.5	test	3.3	r1C5	8.0	Nurses and midwives	2.3
d_1c8	2.6	c8	-4.0	r1C6	7.8	Hospital beds	2.2
d_1contact	2.0	c3	-11.1	r2_C7	7.0	Population, ages 65 and above	2.1
d_1c7	-2.4	c4	-11.5	r2_C6	6.7	Incidence of tuberculosis	-2.7
d_1c6	-5.1	c2	-11.6	r1_C0	5.2	International tourism, number of arrivals	-3.2
d_1c5	-7.0	c1	-12.0	r3C6	5.2		
		c7	-13.0	r2C2	4.9		
		c6	-13.2	r2_C5	4.9		
		c5	-13.4	r3_C2	4.6		
		c0	-15.2	r3_C4	4.3		
				r_1c2	4.3		
				r1_C4	4.0		
				r2_C4	3.9		
				r3_C1	3.7		
				r2C3	3.2		
				r1_C8	2.5		
				r2_C1	2.0		
				r1_C1	2.0		
				r2_test	-3.3		
				r2_contact	-3.4		
				r3_test	-4.5		
				r1_contact	-5.6		

Table 11: Full list of variables characterising the "very low severity" class in the cross-sectional sample and their test value according to the severity measurement variant

Indicator	Category	Dependent variable				
		Score_avg	Score_pic	Score_wght	Score_last	Score_min
d_1_test	Stringency at introduction			2.1		
d_1c0	Stringency at introduction	**3.1**	**2.0**	**2.4**		**2.5**
d_1c5	Stringency at introduction	- 2.1				- 2.4
d_1c6	Stringency at introduction	- 2.2				
score_maxc4	Maximum stringency			- 3.1		
score_maxc5	Maximum stringency	- 2.3				- 2.2
score_maxc6	Maximum stringency	- 3.0		- 2.7		- 2.0
score_maxc7	Maximum stringency			- 2.2		
score_maxc8	Maximum stringency				2,2	
score_maxtest	Maximum stringency	**2.6**		**2.1**		**2.1**
r_1	Speed of introduction	2.9	2.2			3.0
r_1_C8	Speed of introduction	2.3	2.2			2.5
r_1C5	Speed of introduction	2.3				2.7
r_1C6	Speed of introduction	3.2		2.4		
r_2-C0	Speed of introduction				- 2,0	
r_2_C5	Speed of introduction	2.2				2.0
r_3_C1	Speed of introduction	2.0		2.0		2.2
r_3C6	Speed of introduction	2.3				
r1_C4	Speed of introduction			2.3		
r2_C4	Speed of introduction			2.6		
r2_C6	Speed of introduction	3.0		3.3		2.8
r2_C7	Speed of introduction	2.7		2.9		3.1

r3_C4	Speed of introduction	2.0		2.4		2.1
r4_C4	Speed of introduction	3.1	2.7	3.8		2.4
Médian Age	Structural factor				- 3.3	2.1
GDP per capita (current US$)	Structural factor				- 2.4	2.5
Incidence of malaria (per 1,000 population at risk)	Structural factor				3.8	
Incidence of tuberculosis (per 100,000 people)	Structural factor				2.2	- 2.2
International tourism, number of arrivals	Structural factor				- 2.1	
Life expectancy at birth, total (years)	Structural factor				- 3.5	2.7
Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 (%)	Structural factor				2.1	- 2.1
Nurses and midwives (per 1,000 people)	Structural factor					2.6
Physicians (per 1,000 people)	Structural factor	2.0			- 3.3	
Population ages 65 and above (% of total population)	Structural factor				- 2.8	

Table 12: The explanatory variables retained for the multivariate analyses

variables	Associated VIF
bcg1980	2.1
bcg1990	2.6
bcg2000	2.2
c1	3.9
c2	3.7
c3	4.4
c4	4.2
c5	4.2
c6	4.2
c7	4.1
c8	2.4
r_1	7.2
r_1_C8	4.0
r_1_contact	2.1
r_1_test	2.1
r_1c2	5.8
r_1C5	5.9
r_1C6	4.3
r_2	5.4
r_2_contact	8.2
r_2_test	5.1
r_2c2	5.6
r_3_test	5.0
r_C4	7.1

cont1_C7	7.6
contact	3.6
GDPpercapita.currentUS.	6.5
Hospital.beds.per.1.000people.	4.2
Incidenceofmalaria.per.1.000.population.at.risk.	2.3
Incidenceoftuberculosis.per100.000people.	2.0
MortalityfromCVD.cancer,diabetesorCRDbetweenexactages30and70.	2.5
Nursesandmidwivesper1.000people.	7.2
Physiciansper1.000people.	4.3
Populationages65andaboveoftotalpopulation.	7.3
Populationdensity of peoplepersq.kmoflandarea.	1.8
score_maxc1	7.6
score_maxc2	5.2
score_maxc3	7.8
score_maxc4	8.1
score_maxc6	4.4
score_maxc7	7.6
score_maxc8	2.2
score_maxcontact	5.0
score_maxtest	6.5
d__test	2.7
d_c	2.4
d_c1	2.4
d_c2	2.5
d_c3	2.4

d_c4	2.8
d_c5	5.6
d_c6	3.1
d_c7	3.6
d_c8	2.0
d_contact	3.2
temp	3.7
test	4.0

Table 13: The panel regression results

Goodness of fit statistics:

Rsq	0.271
Adjrsq	0.260

Coefficients:			
	Estimate	**Std. Error**	**Pr(>|t|)**
(Intercept)	0.954	0.044	0.000
bcg1980	0.000	0.000	0.000
bcg1990	0.000	0.000	0.000
bcg2000	0.000	0.000	0.001
c1	-0.007	0.003	0.022
c2	-0.015	0.004	0.000
c3	0.004	0.006	0.508
c4	-0.010	0.003	0.001
c5	-0.018	0.004	0.000
c6	-0.008	0.004	0.045
c7	-0.011	0.004	0.008
c8	-0.010	0.003	0.000
r_C4	0.000	0.000	0.170
r_C7	0.000	0.000	0.474
contact	0.034	0.007	0.000
Continent - America	-0.078	0.010	0.000
Continent - Asia	0.018	0.009	0.059
Continent - Europe	-0.098	0.014	0.000
Continent - Oceania	0.105	0.020	0.000
d_.test	-0.009	0.007	0.237
d_c	0.003	0.001	0.000
d_c1	0.006	0.006	0.304
d_c2	0.003	0.004	0.405
d_c3	0.007	0.007	0.294
d_c4	0.006	0.003	0.040
d_c5	0.028	0.006	0.000
d_c6	-0.020	0.004	0.000
d_c7	-0.010	0.007	0.140
d_c8	-0.018	0.003	0.000
d_contact	-0.006	0.007	0.388
Hospitalbedsper1.000people.	-0.004	0.002	0.023
Incidenceofmalariaper1.000populationatrisk.	0.000	0.000	0.017

Incidenceoftuberculosisper100.000people.	0.000	0.000	0.000
MortalityfromCVD, cancer, diabetesorCRDbetweenexactages30and70.	0.002	0.001	0.000
Nursesandmidwivesper1.000people.	-0005	0.001	0.000
Physiciansper1.000people.	0012	0.003	0.000
Populationages65andaboveoftotalpopulation.	0004	0.001	0.001
Populationdensitypeoplepersqkmoflandarea.	0000	0.000	0.000
r_1	0000	0.000	0.172
r_1.C1	0000	0.000	0.739
r_1.C8	0001	0.000	0.000
r_1.contact	0000	0.000	0.858
r_1.test	0.000	0.000	0.000
r_1c2	0.000	0.000	0.188
r_1C5	0.000	0.000	0.000
r_1C6	0.000	0.000	0.102
r_2	0.000	0.000	0.139
r_2.contact	0.000	0.000	0.000
r_2.test	0.000	0.000	0.000
r_2c2	0.000	0.000	0.228
r_3.test	0.000	0.000	0.000
Temp	-0.001	0.001	0.311
Test	-0.026	0.005	0.000

Table 14: RESULTS OF THE cross-sectional regressions

- **score_avg as the dependent variable**

R^2	0.349
R^2 adjusted	0.291

	Valeur	Erreur standard	Pr > |t|
Constant	0.805	0.048	**< 0.0001**
r_1	0.000	0.000	
r_2	0.000	0.000	
d_co	0.005	0.001	**0.000**
r_1c2	0.000	0.000	
r_2c2	0.000	0.000	
d_c2	0.000	0.000	
d_c3	0.000	0.000	
r_1C5	0.000	0.000	
d_c5	0.000	0.000	
r_1C6	0.000	0.000	**0.002**
d_c6	0.000	0.000	
r_1_contact	0.000	0.000	
r_2_contact	0.000	0.000	
d_contact	0.000	0.000	
r_1_test	0.000	0.000	
r_2_test	0.000	0.000	
r_3_test	0.000	0.000	
d__test	0.000	0.000	
d_c1	0.000	0.000	
r_1_C8	0.000	0.000	
d_c8	-0.015	0.007	**0.033**
cont1_C7	0.000	0.000	
d_c7	0.000	0.000	
cont1_C4	0.000	0.000	
d_c4	0.000	0.000	
Incidence of malaria (per 1,000 population at risk)	0.000	0.000	**0.003**
Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 (%)	0.003	0.001	0.071
Population ages 65 and above (% of total population)	0.006	0.002	**0.009**
Population density (people per sq. km of land area)	0.000	0.000	**< 0.0001**
Hospital beds (per 1,000 people)	0.000	0.000	
Incidence of tuberculosis (per 100,000 people)	0.000	0.000	**0.000**
Nurses and midwives (per 1,000 people)	0.000	0.000	
Physicians (per 1,000 people)	0.000	0.000	

bcg2000	0.000	0.000	
bcg1990	0.000	0.000	
bcg1980	0.000	0.000	
temp	0.000	0.000	
log (GDP)	0.000	0.000	
Continent Africa	-0.081	0.032	**0.013**
Continent - America	-0.172	0.025	**< 0.0001**
Continent - Asia	-0.058	0.027	**0.031**
Continent - Europe	-0.171	0.031	**< 0.0001**
Continent - Oceania	0.000	0.000	

- **score_min as the dependent variable**

R^2	2.83E-01
R^2 adjusted	2.13E-01

	Value	Standard Error	Pr > |t|
Constant	7.49E-01	0.059	**0.000**
bcg1980	0.00E+00	0.000	
bcg1990	0.00E+00	0.000	
bcg2000	0.00E+00	0.000	
cont1_C4	-4.76E-04	0.000	0.109
cont1_C7	0.00E+00	0.000	
Continent - Africa	-1.76E-01	0.046	**0.000**
Continent - America	-2.19E-01	0.038	**0.000**
Continent - Asia	-1.07E-01	0.044	**0.015**
Continent - Europe	-2.28E-01	0.043	**0.000**
Continent - Oceania	0.00E+00	0.000	
d__test	0.00E+00	0.000	
d_c0	5.46E-03	0.002	**0.020**
d_c1	0.00E+00	0.000	
d_c2	0.00E+00	0.000	
d_c3	0.00E+00	0.000	
d_c4	0.00E+00	0.000	
d_c5	0.00E+00	0.000	
d_c6	0.00E+00	0.000	
d_c7	-3.86E-02	0.019	**0.045**
d_c8	0.00E+00	0.000	
d_contact	0.00E+00	0.000	
Hospital beds (per 1,000 people)	0.00E+00	0.000	

Incidence of malaria (per 1,000 population at risk)	2.69E-04	0.000	**0.003**
Incidence of tuberculosis (per 100,000 people)	-2.26E-04	0.000	**0.004**
log (GDP)	0.00E+00	0.000	
Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 (%)	0.00E+00	0.000	
Nurses and midwives (per 1,000 people)	-6.50E-03	0.003	0.057
Physicians (per 1,000 people)	0.00E+00	0.000	
Population ages 65 and above (% of total population)	8.38E-03	0.004	0.055
Population density (people per sq. km of land area)	-4.90E-05	0.000	**0.000**
r_1	0.00E+00	0.000	
r_1_C8	0.00E+00	0.000	
r_1_contact	0.00E+00	0.000	
r_1_test	0.00E+00	0.000	
r_1c2	0.00E+00	0.000	
r_1C5	2.57E-04	0.000	0.064
r_1C6	0.00E+00	0.000	
r_2	0.00E+00	0.000	
r_2_contact	0.00E+00	0.000	
r_2_test	0.00E+00	0.000	
r_2c2	0.00E+00	0.000	
r_3_test	0.00E+00	0.000	
temp	0.00E+00	0.000	

- **score_last as the dependent variable**

Observations	147,000
R^2	0.317
R^2 adjusted	0.245

Source	Value	Standard Error	Pr > |t|
Constant	1.04E+00	0.126	**< 0.0001**
bcg1980	0.00E+00	0.000	
bcg1990	0.00E+00	0.000	
bcg2000	0.00E+00	0.000	
cont1_C4	0.00E+00	0.000	
cont1_C7	6.72E-04	0.000	**0.017**
Continent - Africa	-1.58E-01	0.046	**0.001**
Continent - America	-2.01E-01	0.040	**< 0.0001**
Continent - Asia	-1.40E-01	0.040	**0.001**
Continent - Europe	-2.24E-01	0.039	**< 0.0001**

Continent - Oceania	0.00E+00	0.000	
d__test	0.00E+00	0.000	
d_c0	4.61E-03	0.002	**0.012**
d_c1	3.58E-02	0.017	**0.034**
d_c2	0.00E+00	0.000	
d_c3	0.00E+00	0.000	
d_c4	0.00E+00	0.000	
d_c5	0.00E+00	0.000	
d_c6	0.00E+00	0.000	
d_c7	4.37E-02	0.020	**0.028**
d_c8	-2.31E-02	0.011	**0.032**
d_contact	0.00E+00	0.000	
Hospital beds (per 1,000 people)	0.00E+00	0.000	
Incidence of malaria (per 1,000 population at risk)	0.00E+00	0.000	
Incidence of tuberculosis (per 100,000 people)	0.00E+00	0.000	
log (GDP)	-5.51E-02	0.023	**0.017**
Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 (%)	0.00E+00	0.000	
Nurses and midwives (per 1,000 people)	0.00E+00	0.000	
Physicians (per 1,000 people)	0.00E+00	0.000	
Population ages 65 and above (% of total population)	0.00E+00	0.000	
Population density (people per sq. km of land area)	0.00E+00	0.000	
r_1	0.00E+00	0.000	
r_1_C8	0.00E+00	0.000	
r_1_contact	0.00E+00	0.000	
r_1_test	0.00E+00	0.000	
r_1c2	-7.20E-04	0.000	**0.005**
r_1C5	0.00E+00	0.000	
r_1C6	4.76E-04	0.000	**0.001**
r_2	0.00E+00	0.000	
r_2_contact	0.00E+00	0.000	
r_2_test	-2.56E-04	0.000	**0.048**
r_2c2	5.61E-04	0.000	**< 0.0001**

r_3_test	0.00E+00	0.000	
temp	0.00E+00	0.000	

- **score_wght as the dependent variable**

R^2	0.155
R^2 adjusted	0.119

	Value	Standard Error	Pr > |t|
Constant	7,34E-01	0.062	**0.000**
bcg1980	0,00E+00	0.000	
bcg1990	0,00E+00	0.000	
bcg2000	0,00E+00	0.000	
cont1_C4	0,00E+00	0.000	
cont1_C7	0,00E+00	0.000	
Continent - Africa	-2,64E-02	0.058	0.650
Continent - America	-1,25E-01	0.054	**0.022**
Continent - Asia	-1,83E-02	0.055	0.741
Continent - Europe	-2,49E-01	0.062	**0.000**
Continent - Oceania	0,00E+00	0.000	
d_1_test	0.00E+00	0.000	
d_1c0	0.00E+00	0.000	
d_1c1	0.00E+00	0.000	
d_1c2	0.00E+00	0.000	
d_1c3	0.00E+00	0.000	
d_1c4	0.00E+00	0.000	
d_1c5	0.00E+00	0.000	
d_1c6	0.00E+00	0.000	
d_1c7	0.00E+00	0.000	
d_1c8	0.00E+00	0.000	
d_1contact	0.00E+00	0.000	
Hospital beds (per 1,000 people)	0.00E+00	0.000	
Incidence of malaria (per 1,000 population at risk)	0.00E+00	0.000	
Incidence of tuberculosis (per 100,000 people)	0.00E+00	0.000	
log (GDP)	0.00E+00	0.000	
Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 (%)	0.00E+00	0.000	
Nurses and midwives (per 1,000 people)	0.00E+00	0.000	
Physicians (per 1,000 people)	0.00E+00	0.000	
Population ages 65 and above (% of total population)	9.80E-03	0.003	**0.005**
Population density (people per sq. km of land area)	-4.65E-05	0.000	**0.000**
r_1	0.00E+00	0.000	

r_1_C8	0.00E+00	0.000	
r_1_contact	0.00E+00	0.000	
r_1_test	0.00E+00	0.000	
r_1c2	0.00E+00	0.000	
r_1C5	0.00E+00	0.000	
r_1C6	0.00E+00	0.000	
r_2	0.00E+00	0.000	
r_2_contact	0.00E+00	0.000	
r_2_test	0.00E+00	0.000	
r_2c2	0.00E+00	0.000	
r_3_test	0.00E+00	0.000	
temp	0.00E+00	0.000	

- **score_pic as the dependent variable**

R^2	0.155
R^2 adjusted	0.119

	Value	Standard Error	Pr > |t|
Constant	7.34E-01	0.062	**0.000**
bcg1980	0.00E+00	0.000	
bcg1990	0.00E+00	0.000	
bcg2000	0.00E+00	0.000	
cont1_C4	0.00E+00	0.000	
cont1_C7	0.00E+00	0.000	
Continent - Africa	-2.64E-02	0.058	0.650
Continent - America	-1.25E-01	0.054	**0.022**
Continent - Asia	-1.83E-02	0.055	0.741
Continent - Europe	-2.49E-01	0.062	**0,000**
Continent - Oceania	0.00E+00	0.000	
d_1_test	0.00E+00	0.000	
d_1c0	0.00E+00	0.000	
d_1c1	0.00E+00	0.000	
d_1c2	0.00E+00	0.000	
d_1c3	0.00E+00	0.000	
d_1c4	0.00E+00	0.000	
d_1c5	0.00E+00	0.000	
d_1c6	0.00E+00	0.000	
d_1c7	0.00E+00	0.000	
d_1c8	0.00E+00	0.000	
d_1contact	0.00E+00	0.000	
Hospital beds (per 1,000 people)	0.00E+00	0.000	

Incidence of malaria (per 1,000 population at risk)	0.00E+00	0.000	
Incidence of tuberculosis (per 100,000 people)	0.00E+00	0.000	
log (GDP)	0.00E+00	0.000	
Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 (%)	0.00E+00	0.000	
Nurses and midwives (per 1,000 people)	0.00E+00	0.000	
Physicians (per 1,000 people)	0.00E+00	0.000	
Population ages 65 and above (% of total population)	9.80E-03	0.003	**0.005**
Population density (people per sq. km of land area)	-4.65E-05	0.000	**0.000**
r_1	0.00E+00	0.000	
r_1_C8	0.00E+00	0.000	
r_1_contact	0.00E+00	0.000	
r_1_test	0.00E+00	0.000	
r_1c2	0.00E+00	0.000	
r_1C5	0.00E+00	0.000	
r_1C6	0.00E+00	0.000	
r_2	0.00E+00	0.000	
r_2_contact	0.00E+00	0.000	
r_2_test	0.00E+00	0.000	
r_2c2	0.00E+00	0.000	
r_3_test	0.00E+00	0.000	
temp	0.00E+00	0.000	

About EMNES

The Euro-Mediterranean Network for Economic Studies (EMNES) is a network of research institutions and think tanks working on socio-economics policy in the Euro-Mediterranean. EMNES is coordinated by the Euro-Mediterranean Economists Association (EMEA).

The research conducted by EMNES Researchers, Associates and Fellows aims to design sound and innovative socio-economic models that are inclusive, sustainable and employment creative, to devise new models for regional integration and to provide policy recommendations towards this goal.

EMNES research agenda is organized around the following mutually reinforcing and interconnected themes led by EMNES researchers, associates and fellows:

- Governance, institutions and institutional reforms;
- Macroeconomic policies and employment creation;
- Private sector, micro, small and medium –sized enterprises development, entrepreneurship and social business;
- Digital economy;
- Healthcare policy;
- Human capital development, education, innovation, skill mismatch and migration;
- Labor markets, employment and employability;
- Finance, financial inclusion and the real economy;
- Sustainable development;
- Regional integration;
- Euro-Mediterranean economic partnership;
- Scenarios analysis and foresight.

EMNES performs **research activities**, disseminated through series of internal and external publications (studies, working papers, policy papers, policy-graphics and books) and the organization of **annual conferences**, and **policy workshop meetings and online webinars** to bring together leading researchers, policy makers and representatives of the civil society to discuss and debate optimal policies for the future of the region.

EMNES research and outputs are underpinned on the **four fundamental principles: Independence, Scientific Excellence, Policy Relevance and Deep Knowledge of Euro-Mediterranean Affairs**.

EMNES acknowledges the financial assistance of the European Union within the context of the EU project "Support to economic research, studies and dialogue of the Euro-Mediterranean Partnership" under contract number ENPI/2014/354-488 (2014-2019).

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