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Health Vulnerability versus Economic Resilience to the Covid-19 pandemic: Global Evidence

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Health Vulnerability versus Economic Resilience to the Covid-19 pandemic: Global Evidence**Simplice A. Asongu, Samba Diop & Joseph Nnanna**

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Abstract

The purpose of this study is to understand how countries have leveraged on their economic resilience to fight the Covid-19 pandemic. The focus is on a global sample of 150 countries divided into four main regions, namely: Africa, Asia-Pacific and the Middle East, America and Europe. The study develops a health vulnerability index (HVI) and leverages on an existing economic resilience index (ERI) to provide four main scenarios from which to understand the problem statement, namely: ‘low HVI-low ERI’, ‘high HVI-low ERI’, ‘high HVI-high ERI’ and ‘low HVI-high ERI’ quadrants. It is assumed that countries that have robustly fought the pandemic are those in the ‘low HVI-high ERI’ quadrant and to a less extent, countries in the ‘low HVI-low ERI’ quadrant. Most European countries, one African country (i.e. Rwanda), four Asian countries (Japan, China, South Korea and Thailand) and six American countries (USA, Canada, Uruguay, Panama, Argentina and Costa Rica) are apparent in the ideal quadrant.

JEL Codes: E10, E12, E20, E23, I10, I18

Key Words: Novel coronavirus, health vulnerability, economic resilience

1. Introduction

The premise of this study is founded on two concerns in policy and scholarly circles, notably, unfavourable health externalities associated with the Covid-19 pandemic and gaps in the attendant literature. The two motivational elements are expanded in the same chronological order.

First, while writing this paper, the novel coronavirus (i.e. Covid-19 pandemic) has affected 213 countries around the world; over 980,000 deaths have been reported with more than 32,000,000 confirmed cases according to Worldometer Covid-19 Data¹. Beyond the terrible toll on human lives, the Covid-19 pandemic is an unprecedented threat to economic development. Currently the pandemic is affecting the world with a heavy economic impact in terms of higher fiscal deficit, rising prices, lower real household incomes and rising new poor (Diop & Asongu, 2020a; Vos, Martin & Laborde, 2020; ILO, 2020), productivity losses, economic contraction (IMF, 2020), reduction in remittances flows (Bisong, Ahairwe & Njoroge, 2020), *inter alia*. Nevertheless, the impact of the shock depends on health vulnerability and the ability of an economy to withstand or recover from the effects of the pandemic (i.e. economic resilience) (Asongu, Diop & Nnanna, 2020).

Second, whereas the literature has documented the consequences of the Covid-19 pandemic, we still know very little about how countries are responding to the underlying crisis in the light of the nexus between economic resilience and health vulnerability. For instance, Agbe (2020), Farayabi and Asongu (2020), Ozili (2020), Price and van Holm, (2020), Nicola et al. (2020), and Bisong et al. (2020) have been concerned with the socio-economic consequences of the crisis. Ataguba, (2020) focuses on the insights from policy and scholarly circles about the crisis while Ozili (2020) investigates opportunities, socio-economic policies and policy initiatives pertaining to the crisis. Bisong et al., (2020) are concerned with how remittances flows have been disrupted by the crisis; Agbe (2020) is concerned with nexuses between how the pandemic has affected childhood poverty experiences while Obeng-Odoom, (2020) examines linkages between social stratification, inequality and the crisis. Amankwah-Amoah, (2020) focuses on how the environment is being affected by the Covid-19 crisis while Odeyemi et al. (2020) are concerned with how laboratories have been responding to the ongoing pandemic.

¹<https://www.worldometers.info/coronavirus>. This page is consulted on the 22nd of September 2020.

The positioning of this study on global evidence surrounding health vulnerability versus economic resilience to the Covid-19 pandemic is premised on sparse literature focusing on the nexus. Hence, this study contributes to the extant literature by leveraging on a recent economic resilience index (Diop, Asongu & Nnanna, 2020) to establish how health vulnerability is related to economic resilience. Hence, for the purpose of the research, the first objective is to calculate a new index with which to quantify health vulnerability before an assessment of the problem statement motivating the study. This narrative, therefore, clearly articulates how the focus of the present study departs from Diop et al. (2020) who have complemented the extant literature by providing economic vulnerability and resilience indexes related to the Covid-19 pandemic.

In the light of the above, the objective of this paper is to find a link between health vulnerability and economic resilience in order to identify countries more exposed to the crisis as well as those that are able to face the pandemic with some effectiveness. More specifically, the study seeks to assess which countries can combat the pandemic with their economic resilience in the light of their health vulnerability levels. The rest of the paper is structured as follows. Section 2 presents the data and method while the results and corresponding discussion are disclosed in Section 3. Section 4 concludes with implications and future research directions.

2. Data presentation and method

We follow the methodological underpinnings of Diop et al. (2020) and Asongu and Diop (2020). Hence, the Panel Component Analysis (PCA) is used as empirical strategy. Before computing the index, we first select the variables to fit the theoretical framework. To construct the Health Vulnerability Index (HVI), the data selection is guided by the theoretical framework based on health exposure to the Covid-19 pandemic. The data description and corresponding justifications are provided in Table 1. Accordingly, ten variables are used for the HVI.

In the second step, we have different measurement units in our dataset bearing in mind that normalization is required prior to the data aggregation. For our index, consistent with the underpinning literature (Diop et al., 2020; Asongu & Diop, 2020), we apply the well-known min-max method. The transformation is:

$$I_{qc} = \frac{x_{qc} - \min_c(x_q)}{\max_c(x_q) - \min_c(x_q)}$$

where x_{qc} the value of indicator q for country c . The minimum and the maximum values for each indicator are calculated across countries. For indicators such as external debt, consumer price index, unemployment and fiscal deficit where higher values imply lower resilience, we use the following transformation:

$$I_{qc} = 1 - \frac{x_{qc} - \min_c(x_q)}{\max_c(x_q) - \min_c(x_q)}$$

Finally, we use a multivariate data analysis technique for the data aggregation. More specifically, the PCA is employed with the objective of elucidating the observed variance of data that is observed via linear nexuses of the original data. Loadings obtained from the PCA are used to compute the different weights instead of giving the same weight to all variables. The first step consists of applying PCA on the variables in each dimension in order to derive alternative weights. Upon the derivation of the weights, the PCA is employed to the sub-indexes that are weighted to compile the HVI.

3. Results and discussion

We first apply the PCA to the selection of the number of components. The general rule (Kaiser Criterion) which does not take on board all factors which have eigen values that are lower than 1 is adopted for the purpose of retaining principal components (Tchamyou, 2017, 2020; Diop & Asongu, 2020b). The corresponding results are provided in Table 2. Only the first-two components have eigenvalues that are greater than 1. Hence, it is concluded that the first-two principal factors elicit the variability of HVI (almost 70% of the variability).

The first objective of this index calculation is to quantify the health vulnerability and to examine which countries are most exposed to the coronavirus in the light of the underlying vulnerability. Mapping is employed for this purpose. Before drawing the map, Table 3 summarizes the results of the HVI by regions. African is the most vulnerable region (0.55) and is followed by Americas (0.49) and Asia-Pacific and Middle East (0.47). Europe has the best score (0.44).

In order to obtain a more descriptive analysis of the distribution of the HVI, we can exploit the mapping in Figure 1. The main finding of the mapping is that, a number of highly

vulnerable countries, including African countries (with the exception of Rwanda), southern Americas countries (with the exception of Ecuador and Uruguay), Eastern European and some Asian countries, are very exposed to the Covid-19 pandemic. African countries are mostly exposed to the Covid-19 pandemic due their weak health systems and lack of health infrastructure despite their significant youth population and moderate prevalence of obesity among adults. This is broadly consistent with Diop and Asongu (2020a) who have shown that the Covid-19 pandemic highlights another pandemic crisis in Africa. In fact, the authors find an unacceptable scarcity of health facilities such as the lack of care capacity (number of hospital beds, Intensive Care Units and ventilators) and infrastructure in the continent. The high vulnerability in Eastern Europe and Southern America could be explained by some characteristics such as high prevalence of diabetes and overweight.

To depict the link between the HVI and the economic resilience index (ERI), four scenarios or quadrants are provided to illustrate countries included in sample. The position of the countries in a quadrant depends on their HVI and ERI characteristics. Regarding the ERI, we use the index proposed by Diop et al. (2020). The authors construct the index using nine indicators ('agriculture, forestry and fishing value added', governance effectiveness, regulatory quality, control of corruption, external debt stocks, consumer price index, unemployment, fiscal deficit and the Human Development Index).

The next step consists of combining the two indexes in order to test if economic resilience can be weapon in the fact against the pandemic. The scenarios are: 'low HVI-low ERI', 'high HVI-low ERI', 'high HVI-high ERI' and 'low HVI-high ERI'. We assume that the only countries which could face the pandemic are those in the 'low HVI-high ERI' quadrant and to a less extent, countries in the 'low HVI-low ERI' quadrant. To separate the different quadrants, we use the averages of the indexes for all countries (dashed lines in the figure). Figure 1 draws the different scenarios of the cross analysis between the two indexes. The different results can be summarised as follows:

- Most of the countries (75%) are localized in the 'high HVI-low ERI' and 'low HVI-high ERI' quadrants.
- Consequently, the majority of European countries are apparent in the ideal quadrant (low HVI-high ERI). This finding indicates that Europe is the most effective region to face the pandemic.

- On the contrary, African countries are clustered in the high 'HVI-low ERI' quadrant with the exception of Senegal ('high HVI-high ERI' quadrant), Botswana ('high HVI-high ERI' quadrant), Mauritius ('high HVI-high ERI' quadrant), Kenya ('low HVI-low ERI' quadrant), Uganda ('low HVI-low ERI' quadrant), Algeria ('low HVI-low ERI' quadrant) and Cabo Verde ('low HVI-low ERI' quadrant). Rwanda is the only African country in the ideal quadrant.
- Regarding the Asian countries, only Japan, China, South Korea and Thailand are in the ideal quadrant, the other are scattered in the three other quadrants.
- Six American countries (USA, Canada, Uruguay, Panama, Argentina and Costa Rica) are in the ideal quadrant.

4. Concluding implications and future research directions

Whereas the literature has documented the consequences of the Covid-19 pandemic, we still know very little about how countries are responding to the underlying crisis in the light of their economic resilience. The purpose of this study is to understand how countries have leveraged on their economic resilience to fight the Covid-19 pandemic. The focus is on a global sample of 150 countries divided into four main regions, namely: Africa, Asia-Pacific and the Middle East, America and Europe. The study develops a health vulnerability index (HVI) and leverages on an existing economic resilience index (ERI) to provide four main scenarios from which to understanding the problem statement, namely: 'low HVI-low ERI', 'high HVI-low ERI', 'high HVI-high ERI' and 'low HVI-high ERI' quadrants. It is assumed that countries that have robustly fought the pandemic are those in the 'low HVI-high ERI' quadrant and to a less extent, countries in the quadrant 'low HVI-low ERI' quadrants.

The findings of the study have obvious implications on both scholarly and practical fronts. From the perspective of scholarship, the findings extend the literature on classifying countries in terms of macroeconomic indicators in order to better understand the consequences of policy syndromes such the current Covid-19 pandemic. On the policy view, policy can employ the documented quadrants or established scenarios in order to understand which regions and by extension, which countries in what regions, are robustly fighting the Covid-19 pandemic in the light of their extant economic resilience and health vulnerability characteristics.

The findings also leave for improvement especially as it relates to the constant improvement of the established indicators in the light of changing events underlying the global Covid-19 pandemic. Moreover, as time unfolds, it would be worthwhile to provide the

scientific community and policy makers with more scenarios and/or quadrants in the fight against the crisis, using other measures of resilience and vulnerability to the Covid-19 pandemic.

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Table 1: Data description and justification

Variables	Indicators	Sources	Year	Justifications
Current health expenditure (% of GDP)	Che	WDI	2017	Spending on health should prepare countries for possible health crises. In fact, health expenditure is an investment in health and therefore in better health structures. The Covid-19 pandemic has shown that many countries should invest more in health, especially in intensive care units (ICU). There is a relationship between healthcare capacity (testing systems, ICU, public health infrastructure level) and the current health expenditure.
Density of medical doctors (per 10 000 population)	Doctors	GHO	2018 or nearest year	The number of doctors is part of the healthcare capacity. The Covid-19 pandemic highlights a low level of density of medical doctors especially in developing countries (Diop &Asongu, 2020a). The more the density of medical and physician is low the more the country is vulnerable. The availability of sufficient number of health workers is essential to fighting the pandemic.
International Health Regulation scores	Ihr	GHO	2019	This index is calculated with 13 core capacities averages which include, for example, measures taken at ports, airports and ground crossings to limit the spread of health risks for global health security. It measures a country's ability to prepare for and respond to emerging public health emergencies such as the Covid-19 pandemic. A country could be mostly exposed to the coronavirus with low International Health Regulation (IHR) scores
Age-standardized prevalence of obesity among adults (18+ years) (%)	Overweight	GHO	2016	Obesity is one of the causes of the complications when affected by Covid-19. It increases the risk of severe cases and an even a larger proportion of total death because obesity raises the risk of death from this disease. The Centers for Disease Control and Prevention lists extreme obesity as a high risk of severe Covid-19. People with Covid-19 who are living with overweight or obesity are faced with increased risk of serious Covid-19 complications and death (Blackshow et al., 2020).
UHC: Service coverage index	Uhc	GHO	2017	Service coverage index (which measures coverage of selected essential health services on a scale of 0 to 100). Universal health coverage is defined as ensuring that all people have access to needed health services (including prevention, promotion, treatment, rehabilitation and palliation) of sufficient quality to be effective while also ensuring that the use of these services does not expose the user

the financial hardship.

Urban population (% of total population)	Urban	WDI	2019	Theoretically, highly contagious infectious diseases and dense areas are positively related. Cities with high density are characterised by closer contact between people and more interaction among them. This connection could facilitate the rapid spread of emerging infectious diseases such as the Covid-19 pandemic.
Diabetes prevalence (% of population ages 20 to 79)	Diabetes	WDI	2019	Chronic health like blood pressure, heart diseases and diabetes are known to increase the risk of severe case and complications to Covid-19. In fact people with high prevalence of diabetic are more exposed to a high vulnerability.
Population ages 65 and above (% of total population)	Up_65	WDI	2018	Old age coupled with chronic health could increase the severity of Covid-19 cases. The risk of dying from Covid-19 increases significantly with age. For example, for Nature Analysis ² , for every 1,000 people infected with the coronavirus who are under the age of 50, almost none will die. For every 1,000 people in their mid-seventies or older who are infected, around 116 will die.
Healthy Life Expectancy	Hale	GHO	2018	Healthy Life Expectancy (HALE) reveals the true health of a population contrarily to Life expectancy (LE) which gives an indication of how long a population is expected to live on average (in years).
Number of Hospital beds	Hosp_bed	GHO	2018	The number of hospital beds is an important tool in national health system capacities. A large gap between the current hospital bed capacity and the needed hospital beds would complicate the response to the pandemic (Graig et al., 2020a, 2020b). A country needs enough available hospital beds to respond adequately to the Covid-19 pandemic.

Source: authors

²<https://www.nature.com/articles/d41586-020-02483-2>

Table 2: Number of principal components and weighting

	1	2	3	4	5	6	7	8	9	10
Eig. val.	5.610	1.360	0.781	0.700	0.501	0.321	0.261	0.210	0.180	0.076
Prop.	0.561	0.136	0.078	0.070	0.050	0.032	0.026	0.021	0.018	0.008
Cum	0.561	0.697	0.775	0.845	0.895	0.927	0.953	0.974	0.992	1.000
Squared loadings										
Variables	Overweight	Diabetes	Density	Health_exp	Hale	Hosp_bed	Uhc	Doctors	Ihr	Up-65
F1	0.090	0.007	0.100	0.053	0.147	0.078	0.154	0.144	0.110	0.125
F2	0.155	0.484	0.019	0.082	0.002	0.120	0.007	0.018	0.022	0.089
Weights										
Weights	0.103	0.100	0.084	0.059	0.119	0.086	0.125	0.119	0.093	0.118

Sources: Authors

Table 3: Health Vulnerability Index by region

Regions	Obs	Mean	Std.Dev	Min	Q(25)	Q(50)	Q(75)	Max
Europe	40	0.44	0.04	0.35	0.41	0.43	0.47	0.53
Africa	50	0.55	0.05	0.43	0.51	0.55	0.58	0.64
Americas	25	0.49	0.04	0.42	0.46	0.49	0.50	0.58
Asia-Pacific and Middle East	35	0.47	0.07	0.30	0.42	0.49	0.53	0.60
World	150	0.49	0.07	0.30	0.44	0.49	0.54	0.64

Sources: Authors

Figure 2: Health Vulnerability and Economic resilience

