How Efficient are Government Stringency Responses in Curbing the Spread of the COVID-19 Pandemic?

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Abstract: **This study quantitatively examines the effectiveness of government response policies in abating the spread of COVID-19. We employed daily data spanning from mid-February 2020 to early August 2020 for a panel of 50 African countries. Results of the IRFs of the panel VAR model shows a negative significant long-run effect of government stringent responses on the total number of confirmed COVID-19 cases. This implies that stricter government responses reduce the spread of COVID-19. The robustness of this result was verified with the help of the FMOLS and DOLS estimators. Consequently, this study recommends that African governments should step-up their community screening/testing capacities and continuously organise health campaigns to sensitize the citizens on the importance of respecting COVID-19 barrier measures. Equally, African governments should rethink the health of their citizens by increasing investments in the health sector in order to prevent the devastating health impacts of unexpected future pandemics.**

Key Words: **COVID-19, Panel VAR Model, Government Response Stringency Index, Pandemic Disease.**

I. INTRODUCTION

The coronavirus disease 2019 dubbed COVID-19 that broke out in December 2019 in the Chinese city of Wuhan is believed to be caused by the SARS-CoV-2[1] virus (Lescure et al., 2020). However, in less than nine months since the outbreak of COVID-19 was cranked up in China, the virus has continued spreading across the globe at a geometric rate, and as of August 12th 2020, over 213 countries and territories across the world and 2 international conveyances have been affected by the COVID-19 pandemic (Worldometer, 2020). Although China initially served as the epicentre of the virus, economic globalisation, especially through trade and tourism triggered the spread of the virus as travellers from China served as vectors of the disease to other countries across the world (McKibbin and Fernando, 2020a).

Varied responses from various countries across the world have greatly contributed in curbing the spread of the virus. Hence, although a good number of reported cases have been effectively treated across the world, its evolution however remains uncertain. COVID-19 is thus a great threat to global public health. Consequently, the World Health Organization (WHO) towards the end of January 2020 declared COVID-19 as a public health emergency of international concern, and later declared it a pandemic on the 11th of March 2020 highlighting the need to coordinate international responses to the pandemic. Thus, given that the prevention of diseases transmission is essential in a pandemic (Joynt and Wu, 2020), this makes it imperative for world countries through individual or concerted efforts to adopt appropriate policy responses in preventing the further spread of the disease.

Following the outbreak of the disease, the first five months (between December 2019 and May 2020) saw the world on its knees as most world governments adopted stringent measures from late February 2020 in a bit to curb the spread of the disease. These measures included among others, national lockdowns, travel bans and closure of international borders which in some countries lasted for over three months, and still counting. The formulation of appropriate macroeconomic policies in response to the COVID-19 is a very challenging task to policymakers owing to the highly uncertain nature of the evolution of the virus as well as its health impacts. The health impacts of the disease are often reflected through mortality and morbidity rates[2].

Notwithstanding, besides the health impacts of COVID-19, a majority of companies across the globe have been experiencing declines in production. Transport limitations among coupled with total confinement measures implemented by most countries have greatly decelerated global economic activities. Hence, Maliszewska et al. (2020) estimate that compared to the baseline situation, world trade would decline by 2.5%. The authors further posit that the volume of real trade will decline by 2.48% and 1.87% in Europe and Sub-Saharan Africa respectively. In addition, the educational sector has greatly been affected by the COVID-19 pandemic, and this may have far reaching long term effects on global health given the importance of education in understanding health outcomes.

[1] SARS-CoV-2 denotes Severe Acute Respiratory Syndrome Coronavirus 2 which broke out in November 2002 in the Guangdong Province in China. SARS-CoV-2 just like COVID-19 is a part of a large family of coronaviruses (CoV). Although coronaviruses are transmitted from animals to people, the COVID-19 strain of coronavirus is believed to have originated from a seafood market in the Chinese city of Wuhan in Hubei province. Symptoms of COVID-19 resemble that of the common cold, with those infected often experiencing fever, coughing, and breathing difficulties. However, infection can lead to pneumonia, multi-organ failure and even death, in more severe cases and especially among the elderly with pre-existing chronic health conditions (Lescure et al., 2020; Statista, 2020; Lee and McKibbin, 2004).

[2] Mortality takes into account those who die of the disease while morbidity considers those who are incapacitated or caring for the incapacitated and unable to work for a given period (McKibbin and Fernando, 2020a).

This is because most governments proceeded to complete school closures as a strategy of mitigating the spread of the disease. School closure measures adopted by various countries around the world do not only undermine education, but equally hamper the provision of essential services to children and communities, including access to a balanced diet and parents' ability to go to work (UNESCO, 2020). As of early August 2020, about 1 billion learners, representing over 60% of the student population worldwide were being deprived from attending classes due to school closures adopted by countries around the world in an attempt to contain the spread of the COVID-19 pandemic. This figure represents an improvement from about 1.4 billion learners who could not attend classes in about 138 countries by mid-March 2020. However, while some countries have gradually started reopening their schools, others have remained closed.

After this brief introduction, section 2 provides stylised facts about COVID-19. The methodology used for the study is outlined in section 3. Section 4 discusses the results of the study while the conclusion and policy implications are contained in section 5.

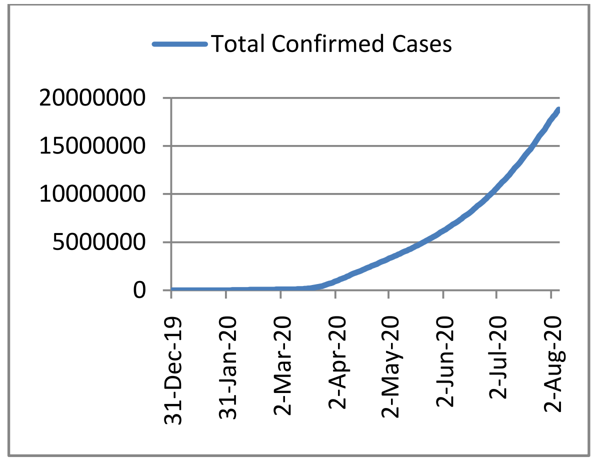
II. STYLISED FACTS ABOUT THE CORONAVIRUS PANDEMIC

2.1. Global Trend of Confirmed COVID-19 Cases

The first cases of COVID-19 were detected in China in early December 2019, and as of December 31st 2019, total confirmed cases of COVID-19 in China were 27. While North America was the first continent to register a confirmed COVID-19 case outside Asia on January 21st 2020 in the United States (US), it was followed by the European continent whose first case was detected in the Paris city in France on January 24th 2020. The disease later spread to Africa, whose first confirmed case was in Egypt on February 14th 2020, before spreading to the South American continent on February 26th 2020 with the first case detected in Brazil. However, while the spread of the disease remained mild between December 2019 and early February 2020, the diseases rapidly spread across many countries from mid-February 2020. Thus, by January 31st 2020, there were about 9,824 confirmed cases globally. This number increased to 85,237 by the end of February 2020, and has increased steadily since then. The global trend for the 213 affected countries and territories across the world (Worldometer, 2020) as of August 11th 2020 are highlighted in figures 1 & 2.

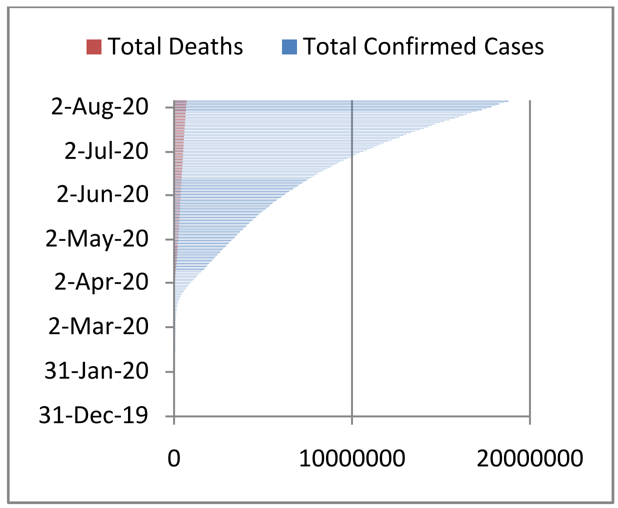
Figure 1 highlights the evolution of the COVID-19 pandemic between December 31, 2019 and July 31, 2020. We observe from figure 1 that confirmed COVID-19 cases have witnessed an exponential upsurge since the start of April 2020. The increased number of confirmed cases between April and July may be due to the increased global awareness of the disease and increased government and international spending on the purchase and adequate use of testing kits.

Figure 1: Evolution of Confirmed COVID-19 Cases



Source: Author's Computations

Figure 2: Global Confirmed COVID-19 Cases and Deaths



Source: Author's Computations

Figure 2 reveals that as of July 31st 2020, the global number of confirmed COVID-19 cases stood at 17,301,610 with a death toll of 673,279 giving a fatality rate of 3.89%. However, as of August 17th 2020, the number of confirmed COVID-19 cases had skyrocketed to about 22 million with a death toll of 773,730 and about 14.5 million recoveries (Worldometer, 2020). Nevertheless, since Africa recorded her first confirmed COVID-19 case on February 14th 2020 in Egypt, the pandemic has however rapidly spread over 50 countries in continent. Thus, as of August 17th 2020, the African continent counts over 1,123,738 confirmed cases, about 25,703 deaths and 839,426 recoveries. Given the poor healthcare facilities and low testing capacity of most African countries, it is obvious that the number of infected persons may be higher than the reported number of confirmed cases. This implies that many infected persons who have not yet been tested may likely die of the disease without being reported. Consequently, the COVID-19 related death trend in Africa may continue to rise in the coming months following the easing of barrier measures across the continent.

2.2. Mitigating the Spread of COVID-19

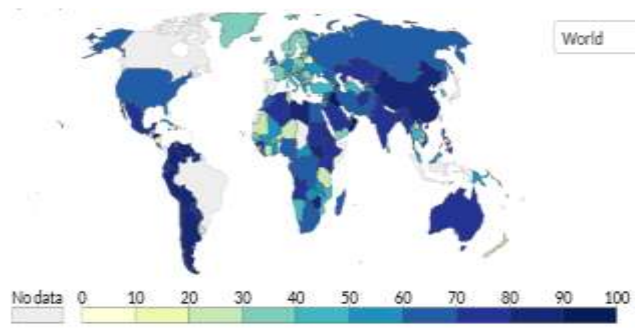
Historically, the health impacts of pandemics have always been devastating. These impacts range from temporal or perpetual incapacitation to the loss of lives. However, although the COVID-19 and the 1918 influenza pandemics remain the only pandemics with the lowest fatality rates below 5%, they remain the deadliest pandemics in the history of pandemics since the twentieth century spreading across over 200 countries. However, unlike the 1918 influenza pandemic in which the death toll was predominant among young people, the death toll of the novel COVID-19 pandemic is predominant among the ageing than the youthful or active population (Covello and Hyer, 2020). Hence, there is need for various governments to develop the health sector in order to mitigate the ever-growing socioeconomic impacts of pandemic diseases such as COVID-19.

Since the escalation of confirmed coronavirus cases across the globe from mid-February this year, various measures to curb the spread of the disease have been proposed and implemented. Thus, international bodies notably the WHO recommended a number of basic hygiene measures that have been adopted by a cross section of countries around the world. These basic hygiene measures proposed by the WHO include: regular washing of hands with soap and running water, use of hand sanitizers, wearing of face-marks in public, covering the mouth and nose when coughing or sneezing, avoid touching the face, practice social distancing, avoid handshaking, and staying at home as much as possible when sick or manifesting any symptoms of the disease.

Besides the basic hygiene measures proposed by the WHO, various governments have adopted stringent containment measures including: internal and international travel bans, school closures, workplace closures, confinement, fiscal or monetary policy measures, and above all national testing policies. It is worthy of note that while a majority of these policies have been implemented by some countries across the world, some countries have criticised the effectiveness of these measures in mitigating the spread of the novel coronavirus pandemic. Figure 3 highlights the Government Response Stringency Index (GRSI)[3] across the world as of August 7th 2020.

Globally, figure 3 reveals that stringent measures have been adopted by a majority of countries around the world. Thus, we observe that government responses in curbing COVID-19 have been very strict in Asian, European and a majority of South American countries, as well as the US, South Africa and Northern African countries, with an average GSRI above 60. Most of these countries experienced complete lockdowns of their economies for at least 30 days between the months of March and June 2020. In addition, most of these countries proceeded to complete closure of schools, workplace closures, cancellation of public events or limitation of the number of persons per gathering, closure of public transport, confinement, and international travel bans among others.

Figure 3: Global Government Stringency Response Index



Source: Adapted from Hale et al. (2020)

A keen look at figure 3 reveals that, only a few African countries implemented very strict measures. For example, South Africa which is the most hit African country observed over 60days of complete lockdown of her economy. Most Northern and Central African countries equally implemented strict barrier measures as can be seen by a GSRI value above 50. However, we observe that most West African countries besides Nigeria and Ivory Coast have not implemented very strict measures as revealed by the low GSRI values below 50.

Surprisingly, despite the implementation of these strict measures by a host of countries, the number of confirmed coronavirus cases has continued rising. This may be due to the fact that most countries only started adopting stringent measures after some persons had already been tested positive of the disease, although McKibbin and Fernando (2020b) had earlier warned on the dangers of attempting to close borders only lately. There have however been numerous debates among researchers on the efficacy of these barrier measures in curbing the spread of the disease which has become one of the deadliest pandemics in modern history. Nevertheless, most governments began easing these strict measures in the months of May and June 2020 owing to the devastating economic impacts that these stringent measures had on the global economy.

III. METHODOLOGY

3.1. Data and Variable Description

The data used in this study is gotten entirely from secondary sources, essentially from Our World In Data (OWID, 2020) database. This study uses panel data collected on a daily basis

[3] The GRSI adopted in this study is a composite measure based on nine response indicators including school closures, workplace closures, and travel bans, fiscal or monetary policy measures, etc (Hale et al., 2020). The GRSI is a simple additive score of nine indicators measured on an ordinal scale, and rescaled to vary from 0 to 100, in which 100 equals the strictest response while 0 implies no response.

for 50 African countries[4] covering a period from February 14th 2020 to the August 5th 2020. Hence, the time frame and countries included in the sample was chosen based on the availability of relevant data and the fact that it was on the 14th of February that the first confirmed case of COVID-19 was registered in Africa. The study attempts to provide a quantitative analysis of the effectiveness of government containment measures (proxied by the government response stringency index, henceforth denoted GRSI) in abating the health impacts of the COVID-19 pandemic. Thus, we consider the total number of confirmed cases per million (henceforth denoted TCCM) as the dependent variable, which is explained by the GRSI and the total number of recorded COVID-19 deaths per million (denoted TDM).

3.2. Model Specification

This study, to the best of our knowledge, provides a novel attempt to quantitatively measure the health impacts of government containment measures with respect to the COVID-19 pandemic. Thus, given that the study makes use of panel data, we specify a panel VAR model based on the Toda-Yamamoto (1995) procedure. Hence, in line with Juodis (2018) the panel VAR is expressed as follows:

$$Y_{it} = v_i + w_i Y_{it-i} + u_{it} \qquad (1)$$

Where: $i = 1, \dots, N$; $t = 1, \dots, T$; Y_{it} is an (n x 1) vector of endogenous variables; w_i are (n x n) matrices of slope coefficients; v_i is an (n x 1) vector of intercepts; u_{it} is an (n x

1) *Vector of random errors.*

However, based on our variables of interest; $Y_{it} = [\mathrm{TCCM}_{it} \quad \mathrm{GRSI}_{it} \quad \mathrm{TDM}_{it}]'$

Consequently, in line with the Toda-Yamamoto procedure (for details, see Emirmahmutoglu and Kose, 2011), we adopt a trivariate panel VAR model specification of equation (1) as follows:

$$\mathrm{TCCM}_{it} = v_{1i} + \sum_{j=1}^{k+m} \alpha_{1ij}\,\mathrm{TCCM}_{it-j} + \sum_{j=1}^{k+m} \beta_{1ij}\,\mathrm{GRSI}_{it-j} + \sum_{j=1}^{k+m} \gamma_{1ij}\,\mathrm{TDM}_{it-j} + u_{1it} \quad (2)$$

$$\mathrm{GRSI}_{it} = v_{2i} + \sum_{j=1}^{k+m} \beta_{2ij}\,\mathrm{GRSI}_{it-j} + \sum_{j=1}^{k+m} \alpha_{2ij}\,\mathrm{TCCM}_{it-j} + \sum_{j=1}^{k+m} \gamma_{2ij}\,\mathrm{TDM}_{it-j} + u_{2it} \quad (3)$$

$$\mathrm{TDM}_{it} = v_{3i} + \sum_{j=1}^{k+m} \gamma_{3ij}\,\mathrm{TDM}_{it-j} + \sum_{j=1}^{k+m} \alpha_{3ij}\,\mathrm{TCCM}_{it-j} + \sum_{j=1}^{k+m} \beta_{3ij}\,\mathrm{GRSI}_{it-j} + u_{3it} \quad (4)$$

Where k is the optimal lag length; m is the maximal order of integration of the variables; α, β, and γ are (3 x 3) matrices of slope coefficients; all other variables remain unchanged.

IV. RESULTS AND DISCUSSION

4.1. Unit Root Results

Table 2: LLC and IPS unit root tests

Levels			First Difference		
Variable	LLC	IPS	LLC	IPS	
	t-statistic (P-value)	t-statistic (P-value)	t-statistic (P-value)	t-statistic (P-value)	Stationarity
TCCM	10.6197 (1.0000)	31.1623 (1.0000)	-1.81584** (0.0347)	-15.0884*** (0.0000)	I(1)
GRSI	-5.99825*** (0.0000)	-8.89524*** (0.0000)	-33.1078*** (0.0000)	-40.7871*** (0.0000)	I(0)
TDM	9.55375 (1.0000)	26.3980 (1.0000)	-7.01796*** (0.0000)	-24.0220*** (0.0000)	I(1)

Source: Authors. Notes: *** & ** denote statistical significance at the 1% & 5% levels respectively; I(0) & I(1) denote stationarity at levels and first difference

The results in table 2 reveal that while TCCM and TDM attain their stationarity after first difference, GRSI is stationary at levels for both the LLC and IPS tests. Thus, our modelled variables are both I(0) and I(1). Furthermore, we observe that unlike the TCCM under the LLC test whose stationarity is justified at the 5% level of significance, the stationarity of the GRSI and TDM are justified at the 1% level of significance for both tests.

4.2. Panel Causality Test

Employing the Toda and Yamamoto (1995) cointegration procedure, we first determined the maximal order of integration (m) of our variables. Thus, following the LLC and IPS unit root results in table 3, we obtain m equals 1 (i.e m=1). Then, we determined the optimal lag length (k). Hence, based on the LR, FPE, AIC, SC and the HQ criteria (presented in table 3), the value of k equal to 4 (i.e k=4) is selected.

[4] The list of 50 African countries selected on the bases of data availability are: Algeria, Angola, Burundi, Benin, Burkina Faso, Botswana, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Cote d'Ivoire, Djibouti, DR Congo, Egypt, Eritrea, Equatorial Guinea , Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Libya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Swaziland, Togo, Tunisia, Tanzania, Uganda, Western Sahara, Zambia, Zimbabwe.

Table 3: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-101975.1	NA	4.00e+09	30.62407	30.62713	30.62513
1	-46826.91	110230.2	257.7799	14.06574	14.07800	14.06997
2	-46160.57	1331.270	211.6022	13.86834	13.88979	13.87575
3	-45566.58	1186.195	177.5115	13.69267	13.72331	13.70325
4	-45240.61	650.6593*	161.3943*	13.59748*	13.63732*	13.61125*

Source: Authors. Notes: * indicates lag order selected by the criterion; LR= sequential modified LR test statistic (each test at 5% level); FPE= Final prediction error; AIC= Akaike information criterion; SC= Schwarz information criterion; HQ= Hannan-Quinn information criterion

Table 4: Toda-Yamamoto Non-causality Analysis

Independent Variables	Dependent variable		
	TCCM	GRSI	TDM
TCCM	…….	0.913444 (0.9692)	261.5314*** (0.0000)
GRSI	7.146060 (0.2100)	…….	11.74553** (0.0384)
TDM	175.3474*** (0.0000)	9.619274* (0.0868)	…….

Source: Authors. Notes: P-values in parentheses ( ); ***; ** & * denotes statistical significance at 1%, 5% and 10% respectively

Having determined the values of k and m, we then conducted the causality test. Table 4 indicates that there exist bidirectional causality between TCCM and TDM as well as between GRSI and TDM. Specifically, there is evidence at the 1% significance level that long-run changes in TCCM can be explained by changes in TDM and vice versa, thereby indicating a feedback effect. We also find evidence at 5% and 10% significance levels that long-run changes in TDM can be explained by changes in GRSI and vice versa, implying that both variables have long-run impacts on each other. Figure 3 provides a synthesis of the causality results.

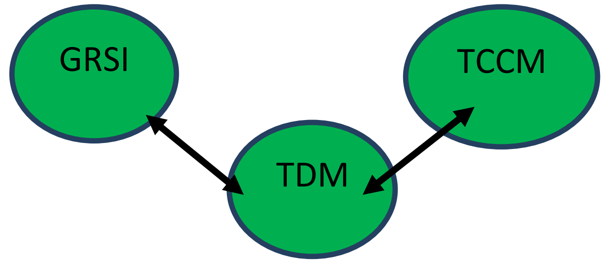


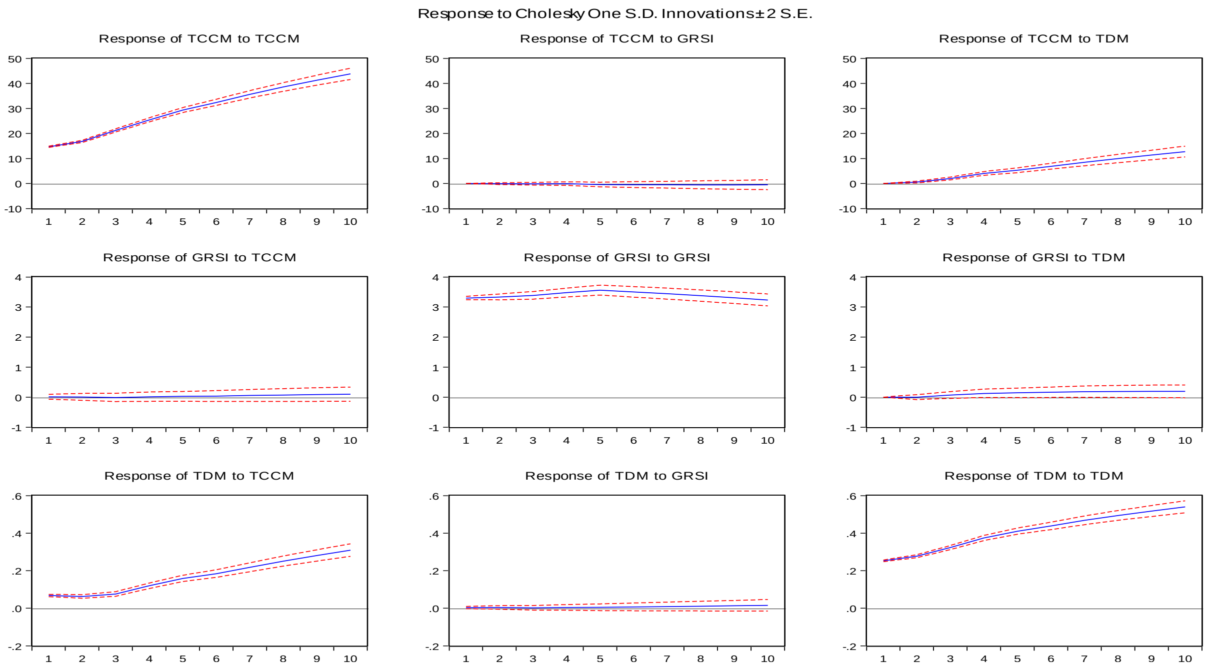
Figure 3 Summary of TY Causality Test

4.3. Impulse Response Analysis

Based on the difficulty of comprehensively interpreting individual coefficients of the P-VAR model, and in order to further examine both the short-run and long-run reaction of various endogenous variables to any of the innovations (shocks or impulses or stochastic error terms) in the specified P-VAR$_{(k+m)}$ model, we estimated impulse response functions (IRFs) over a 10 periods horizon, as presented in figure 4. Empirical evidence from the IRFs in figure 4 indicates that a shock in one of the endogenous variables not only affects the said variable but is as well transmitted to the other endogenous variables through the dynamic structure of the P-VAR model. Specifically, considering the TCCM model, we observe that TCCM positively responds to innovations in GRSI only in the short-run while the effect of GRSI on TCCM is negative in the long-run. This implies that, government stringent measures such as lockdowns and travel bans have the tendency of reducing the rate of contamination in the society especially in the long term.

However, the positive short-run nexus between GRSI and TCCM could be due to the fact that most governments did not believe that the COVID-19 pandemic was a reality during the first two months following the outbreak of COVID-19 given that it was only declared a pandemic by the WHO on March 11 2020. Thus, some of these governments started imposing very strict measures when the pandemic had already spread to a great number of persons across the world. However, McKibbin and Fernando (2020a) had earlier warned of the possible dangers of governments closing borders only after a pandemic had already entered the country. Nevertheless, the long-run negative effect of strict government measures in curbing the spread of the disease is indicative of the fact that there is need for a global synergy so as to reinforce government efforts in fighting the pandemic.

Figure 4: Impulse Response Graphs



Conversely, we observe that TCCM positively responds to forecast errors that occur in total deaths (TDM). This implies that total deaths leads to an increase in the number of infections within the community. This effect is consistent both in the short-run and long-run periods. While the effect is moderate in the short-run (first three periods), the effect is amplified in the long-run. This may be explained primarily by the fact that government stringent measures in most African countries were not accompanied by improvements in health facilities. Another reason could be the fact that most people might have been infected in the community before the adoption of strict measures by various governments. Equally, these government response measures met with resistance and civil disobedience in some countries because most governments failed to provide COVID-19 incentive packages to their populace. The low income and educational levels of most African populations equally contributed to this positive nexus between deaths and confirmed cases.

4.4. Robustness Checks

According to Abrigo and Love (2016), it is important to conduct robustness checks on panel VAR models since the results could be sensitive to the number of lags. Consequently, as a check on the estimated P-VAR model, we employed baseline dynamic panel estimation techniques notably, the fully modified ordinary least squares (FMOLS) and the dynamic ordinary least squares (DOLS) estimators, primarily due to their ability to generate precise and consistent estimates of model parameters. Secondly, the DOLS and FMOLS estimators are capable of eliminating the potential serial correlation and endogeneity of the regressors. The FMOLS and DOLS results are presented in table 5.

Table 5: FMOLS and DOLS Estimates

Dependent Variable: TCCM		
VARIABLE	FMOLS	DOLS
	Coefficient [Std. Error] (t-Statistic)	Coefficient [Std. Error] (t-Statistic)
GRSI	-2.201698*** [0.355963] (-6.185192)	-0.922454** [0.343292] (-2.687081)
TDM	60.23300*** [0.792310] (76.02206)	64.73801*** [0.883561] (73.26945)
R-squared	0.897837	0.972477
Adjusted R-squared	0.897034	0.964301

Source: Authors. Notes: ***; **; mean statistical significance at 1% and 5% respectively

The FMOLS and DOLS results presented in table 5 reveal the existence of a negative significant long-run relation between government response stringency index (GRSI) and the total number of confirmed COVID-19 cases (TCCM) in Africa. This implies that strict government responses have a tendency of reducing the spread of the pandemic disease in Africa. Equally, we observe that the death toll of COVID-19 (TDM) positively impacts the number of confirmed cases. This may partly be explained by the fact that most African countries have poor medical facilities and cannot therefore adequately protect medical personnel charged with burying COVID-19 victims. Furthermore, the fact that some victims die in their homes with large family sizes may facilitate contamination of closed relations who attend the burial ceremony. These results therefore are consistent with the results of the impulse response functions of the panel VAR estimator.

V. CONCLUSION AND POLICY IMPLICATIONS

This study examined the effectiveness of government stringency responses in curbing the spread of the COVID-19 pandemic in a panel of 50 African countries using daily data collected from the OWID database covering the period from February 14th 2020 to the August 5th 2020. Employing the panel VAR modelling framework, results of the impulse response functions (IRFs) show that there exists a negative significant long-run effect of government stringent responses on the total number of confirmed COVID-19 cases. This implies that a strict implementation of government responses will lead to a reduction in the spread of COVID-19 in the long-run. Furthermore, we employed the FMOLS and DOLS estimators as robustness checks on the IRFs results, and found that the results are consistent with those of the IRFs.

Consequently, this study recommends that African governments should step-up their community screening/testing capacities and continuously organise health campaigns to sensitize the citizens on the importance of respecting COVID-19 barrier measures. Equally, African governments should rethink the health of their citizens by increasing investments in the health sector in order to prevent the devastating health impacts of unexpected future pandemics. Various governments can also provide scholarships to students willing to study specialized but costly scientific disciplines that can provide long term solutions to health related problems. Governments should therefore be more proactive than simply being reactive in fighting pandemics. They should prevent future catastrophes by drawing lessons from the devastating health impacts of previous pandemics.

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