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27 September 2020

Online at <https://mpra.ub.uni-muenchen.de/103153/>  
MPRA Paper No. 103153, posted 01 Oct 2020 10:10 UTC

**Modeling and Forecasting  
Economic Growth in Sub-Saharan Africa  
in the Post-COVID Era**

By

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## Abstract

The coronavirus has deleteriously affected a great majority of countries in the world. Developed societies such as the United States and the majority of Western countries have had the highest rates of mortality because of the pandemic. Sub-Saharan Africa, on the other hand, has been the continent where the pandemic has not done excessive damages. Africa's GDP growth did not significantly decrease compared with the other continents. Consequently, the purpose of this paper is to model and forecast economic growth in sub-Saharan Africa in the post-COVID era and to examine the factors that are part of the growth process of the continent. To appropriately develop an econometric model of the economic growth of Sub-Saharan Africa in the post-COVID era, we decided to use the time-series data. This time-series data will be the dataset used to develop the statistical model that will enable us to forecast the economic growth of the continent in the post-COVID era.

**Keywords:** Econometrics, Macroeconomics, Mathematical Modeling, Time-Series Analysis, Autoregressive model, Statistical Modeling

## INTRODUCTION

The world has entirely changed since the dawn of the year 2020. Indeed, a worldwide pandemic known as the coronavirus or COVID-19 for its scientific appellation has deleteriously impacted the world. Many death cases occurred by tens of thousands on a regular basis. As we could see in table 1, the most industrialized countries on the planet have the highest number of confirmed cases and the highest number of deaths compared to African countries.

### Mortality Analyses of COVID-19 in some countries

Countries	Cases Confirmed	Deaths
United States	6,593,269	195,786
India	5,020,359	82,066
Brazil	4,382,263	133,119
Mexico	676,487	71,678
South Africa	653,444	15,705
Spain	603,167	30,004
United Kingdom	376,670	41,753
Italy	289,990	35,633
Ghana	45,655	294
Kenya	36,301	634
Cameroon	20,271	415
Cote d'Ivoire	19,100	120
Congo (Brazzaville)	4,934	88

Table 1. Source: Coronavirus Resource Center, John Hopkins University. Note: The countries represented in this table have been randomly selected.

Civilized society has been then on lockdown since. All governments have imposed a compulsory shelter-in-place policy on their citizens. This mandatory shelter-in-place policy has consequently impacted the economic growth and output of most countries. According to the OECD, year-on-year GDP in the G20 area fell by -9.1 percent in the second quarter of 2020, following a contraction of -1.7 percent in the previous quarter.<sup>1</sup> Among the G20 economies, China recorded the highest annual growth of 3.2 percent, while India recorded the largest annual fall of -23.5 percent.<sup>2</sup>

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<sup>1</sup> “Unprecedented Falls in GDP in most G20 economies in second quarter of 2020.” *G20 GDP Growth Quarterly National Accounts*. OECD. (2020). pp-1-4. Paris.

<sup>2</sup> Ibid. p.1

### Quarterly GDP Growth for the G20 economies

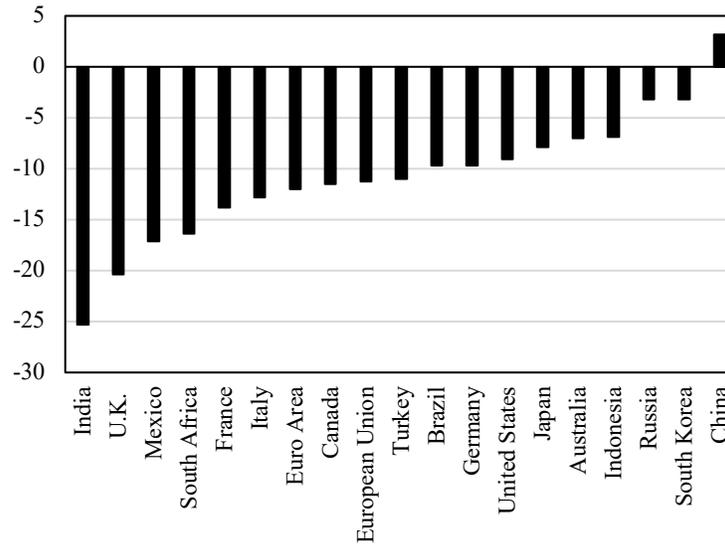


Figure 1. Source. OECD Data Portal

Unlike the steady decline of the economic growth of G20 economies, the GDP growth of Sub-Saharan Africa did decline but not to the extent of G20 countries. As we could see in figure 2, the GDP growth of Sub-Saharan Africa declined from 3.7 percent in 2019 to -1.56 percent in 2020. However, it has been forecasted that its economic growth should increase again in 2021 to 4.08 percent. It is clear that the reason why the GDP growth of West Africa steadily declined during the pandemic is that the economy of South Africa was greatly affected by COVID. Let us not forget that South Africa remains the most advanced economy of the African continent and its economic power does impact a substantial portion of Africa's economy as a whole. If the South African economy is affected, then most African economies are also affected because most of them depend on South Africa's economy.

### GDP Growth of Sub-Saharan Africa from 2000 to 2021

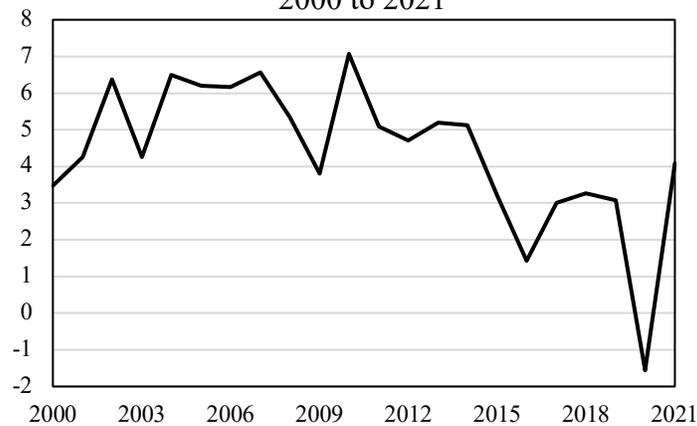


Figure 2. Source: World Bank, Statista

The fundamental question of our analysis is to understand why Sub-Saharan Africa’s economic growth was not as affected as that of the most developed countries. Although the number of COVID-19 cases and fatalities might still appear comparatively low in Africa than in other world’s regions, the looming health shock of COVID-19 could have disastrous impacts on the continent already strained health systems and could quickly turn into a social and economic emergency.<sup>3</sup> Beyond health risks, the COVID-19 shock to African economies has come in three waves: (1) lower trade and investment from China in the immediate term; (2) a demand slump associated with the lockdowns in the European Union and OECD countries; and (3) a continental supply shock affecting domestic and intra-African trade.<sup>4</sup> After recorded its first COVID-19 case in Egypt on February 14, 2020—since then, 52 countries have reported cases.<sup>5</sup> On May 4, 2020, the number of confirmed cases and deaths had risen to 44,3873 and caused 1,807 deaths.<sup>6</sup> The African countries with the highest number of infections at that period were South Africa, Egypt, Morocco, and Algeria.<sup>7</sup> However, the full scope of the pandemic remains uncertain, as cases are underreported and the accuracy of data varies considerably.<sup>8</sup> Most African governments have implemented measures to encourage social distancing on border and travel restrictions, school closures, and bans on large gatherings.<sup>9</sup> South Africa has implemented a 21-day period of full lockdown, and other countries such as Senegal and Côte d’Ivoire instituted curfews and partial lockdowns.<sup>10</sup>

The macroeconomic supply and demand shocks have had adverse impacts on growth. The decline in economic activity and employment in late 2020 and 2021 will be determined by the magnitude and the persistence of the shock, the impact of pre-existing crises and vulnerabilities, and the response by African governments and businesses.<sup>11</sup> It is then clear that although Africa was not as affected as the rest of the world, it will still face the economic consequences of the pandemic but to what extent? Will Sub-Saharan Africa be able to maintain a sustainable level of economic growth on a yearly basis within the next four or five years? To answer this inquiry, we decided to analyze the trend and shape of the data in order to determine the statistical model appropriate for modeling and forecasting the economic growth of Sub-Saharan Africa in forthcoming years.

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<sup>3</sup> “COVID-19 in Africa: Regional Socio-economic Implications and Policy Priorities.” *OECD*. (2020). pp.1-22. Paris.

<sup>4</sup> *Ibid.* p. 1

<sup>5</sup> *Ibid.* p. 2

<sup>6</sup> *Ibid.* p. 2

<sup>7</sup> *Ibid.* p. 2

<sup>8</sup> *Ibid.* p. 2

<sup>9</sup> *Ibid.* p. 2

<sup>10</sup> *Ibid.* p. 2

<sup>11</sup> *Ibid.* p. 3

## THE DATA

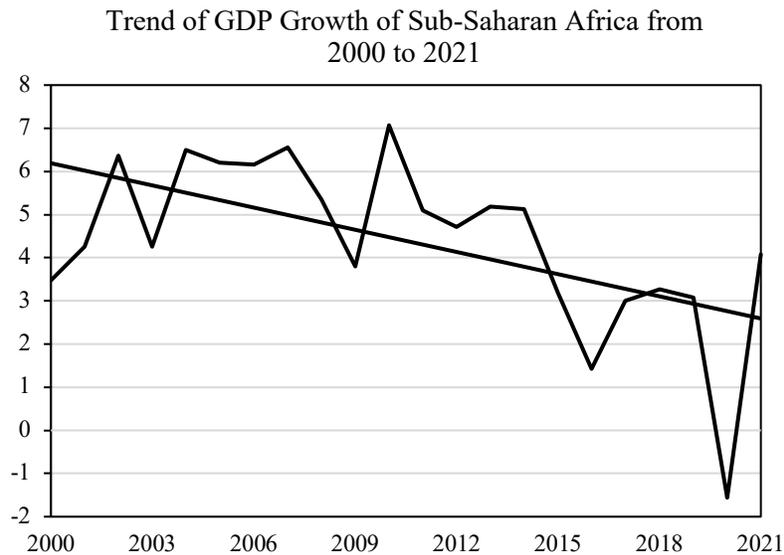


Figure 3. Source: World Bank, Statista

Our data in this analysis consisted of combining the values of the observations of those of the World Bank and those of Statista. The data of the world bank have not been updated since 2019 while the ones of Statista are more recent. Moreover, Statista has already projected the GDP growth of Sub-Saharan Africa to grow back to 4.08 percent in 2021. Consequently, the econometric model we intended to build will forecast the economic growth of Sub-Saharan Africa to 2025. The data that we are working with is time-series data. As we observe the shape and direction, we can subsequently assume that the data have a stationary distribution and its process is weakly dependent. These two indicators enable us to determine the statistical model which will be used for our analysis. The statistical model that we will be using is the Autoregressive model (AR) because there is a correlation between the series and its past values.<sup>12</sup> The data have no specific trend or seasonality. It is stationary because the past values of the data have been constant in their direction and the autocorrelation has been the same throughout the entire series. Consequently, we can argue that the future values of this data will be similar to past values.

## THE MODEL

The model of our analysis can be written as the following equation:

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \varepsilon_t$$

Where ( $Y_t$ ) represents the outcome variable, ( $\beta_1, \beta_2$ ) represents the coefficients of the past values, ( $Y_{t-1}, Y_{t-2}$ ) represents the autocorrelation of the past value at a given time period of the time-series, and ( $\varepsilon_t$ ) represents the error term at any given period within the time-series.

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<sup>12</sup> Horvath, Zsuzanna, Johnston, Ryan. *AR (1) Time Series Process Econometrics 7590*. p. 3.

## SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.58501041
R Square	0.34223718
Adjusted R Square	0.25453547
Standard Error	1.83032546
Observations	18

<i>ANOVA</i>					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	2	26.1460306	13.0730153	3.90228629	0.0432036
Residual	15	50.2513694	3.35009129		
Total	17	76.3974			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	-0.3499283	1.73719441	-0.201433	0.84306615	-4.0526705	3.35281394	-	3.35281394
Lag 1	0.50832885	0.32687898	1.55509801	0.014076556	-0.1883972	1.2050549	-	1.2050549
Lag 2	0.45634377	0.32941358	1.38532166	0.028621032	-0.2457847	1.15847219	-	1.15847219

After determining the values of our model, we are now able to write the whole equation:

$$Y_{(t)} = -0.3499283 + 0.50832885Y_{(t-1)} + 0.45634377Y_{(t-2)} + 1.83032546\epsilon_t$$

## EMPIRICAL EVIDENCE AND FORECASTING

The results of our model do predict the decline of the economic growth of Sub-Saharan Africa in the post-COVID era as we can see in figure 4. The main inquiry in this part of our analysis is to understand why economic growth in Sub-Saharan Africa will be slow instead of skyrocketing.

GDP Growth of Sub-Saharan Africa forecasted to 2025



Figure 4. Source: Author's computation

In 2021, GDP growth is supposed to reach 4.08 percent. Nevertheless, the graph shows that this value will decrease primarily between 2021 and 2022 from 4.08 percent to 3.79 percent. This decline in growth is supposed to continue between 2022 and 2025 from 3.79 percent to 2.45 percent. If Africa is the place that has been the least affected by the pandemic compared to other regions, why is its growth going to be slow at the beginning of the post-COVID era? Two reasons may explain this forthcoming decline within the growth process.

*Reason 1: Africa's Dependency on South Africa's Economy*

South Africa is the country that has been the most affected by the pandemic. It has over 600,000 confirmed cases and more than 15,000 deaths. Its GDP growth in 2020 significantly declined to -16.4 percent. However, in 2021, its GDP growth is supposed to grow back to 4 percent. As we forecasted the GDP growth of South Africa in the next four years to come in figure 5, its growth is also supposed to decline. Its potential growth decline, however, does not mean that it cannot be altered in the meantime.

A great portion of the economy of Sub-Saharan Africa relies on the South African economy. Though the South African economy has been deeply yet deleteriously affected by COVID-19 and the African economies which depend on it have consequently been affected as well. The supply and demand shock at the sectoral level has been going through a recession.<sup>13</sup> The impact of a lockdown on agriculture has been drastically negative during the lockdown period—lockdown regulations permit harvesting and storage activities, to prevent wastage of crops already

<sup>13</sup> Arndt, Channing; Davies, Rob; Gabriel, Sherwin; Harris, Laurence; Makrelov, Konstantin; Modise, Boipuso; Robinson, Sherman; Simbanegavi, Witness; Seventer, Dirk van; Anerson, Lillian. "Impact of COVID-19 on the South African Economy: An Initial Analysis." *Southern Africa – Towards Inclusive Economic Development in Southern Africa*. Working Paper 111. (2020). pp.1-37.

planted and to tend to livestock.<sup>14</sup> In the manufacturing sector, many jobs have been also affected by the lockdown. Production of food and non-alcoholic beverages is expected to continue although mild reductions in production have occurred.<sup>15</sup> In the service sector, production has not necessarily but it has been adjusted. Since South Africa is technologically advanced with high internet penetration, employers in that sector did not necessarily lose their job but they had to adjust to working remotely. In addition to the impact of COVID-19 on the sectoral level, COVID-19 has also impacted the country on the exports and investment level. As many countries use similar containment measures to respond to the spread of COVID-19, factory shutdowns and reductions in global commodity demand have had adverse effects on exports.<sup>16</sup> The extent to which exports demand fell—beyond what was expected from the lockdown in South Africa—depended largely on the duration and magnitude of shutdowns in other economies, and their relative importance as an export destination.<sup>17</sup> Sharp contractions in the level of fixed investment are expected, as a highly uncertain outlook on economic activity leads firms to reconsider or postpone decisions on capital projects.<sup>18</sup> Investment expenditure by commodity was expected to drop by 65-80 percent.<sup>19</sup> In many instances, the shutdown of heavy industries and the construction sector preempted the reduction in investment demand.<sup>20</sup>

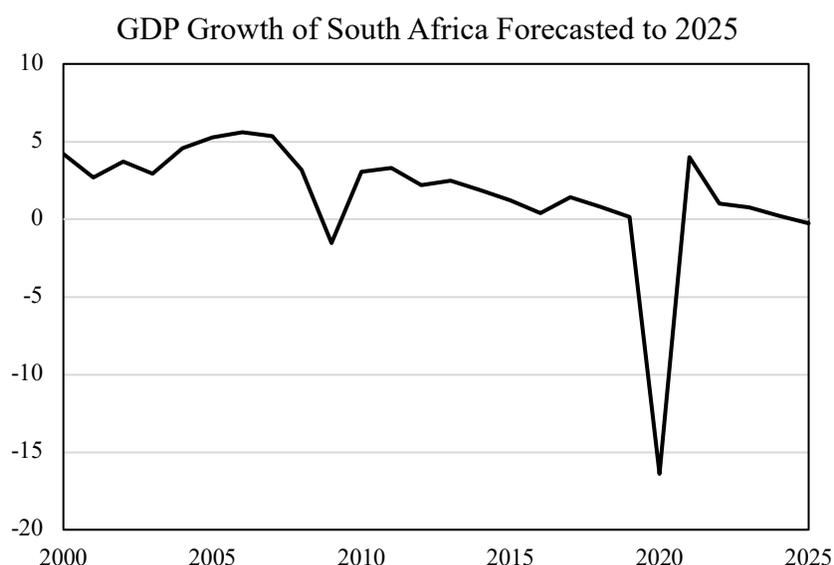


Figure 5. Source: World Bank, Author's Computation

The countries that depend on the South African economy do primarily so on the import-export trade. For March 2020 South Africa had a trade surplus of U.S. \$1.5 billion; for April this changed to a deficit of U.S.\$1.9 billion, a deficit of U.S.\$ 1.6 billion more than the U.S.\$242 million trade deficit recorded for April 2019.<sup>21</sup> The trade deficit can be attributed mainly to a

<sup>14</sup> Ibid. p. 2

<sup>15</sup> Ibid. p. 2

<sup>16</sup> Ibid. p. 5

<sup>17</sup> Ibid. p. 5

<sup>18</sup> Ibid. p. 5

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<sup>20</sup> Ibid. p. 5

<sup>21</sup> Viljoen, Willemien, "South Africa's April 2020 trade statistics—reduced exports lead to a significant trade deficit." *Tralac*. (2020).

significant decline in total exports—in comparison with March 2020 and April, 2019 exports more than halved. Exports to all but a handful of countries decline; the exceptions are some countries in Asia and the Middle East.<sup>22</sup>

It is fair to say that as South Africa plays a major role in the economic growth of Sub-Saharan Africa, its economic growth through the post-COVID era will be more or less a fragile growth. Once again, we reiterate that our forecasting model does not assert that the economic growth of South Africa will be these exact values forecasted. They are just approximations. However, we are confident that the shape of its economy will be heading into a declining direction. As the economic growth of South Africa will be declining during the early years of the post-COVID era, the economic growth of Sub-Saharan Africa will also decline since its economy partially depends on that of South Africa.

### *Reason 2: Lack of Infrastructure and Technology*

The lack of infrastructure in African countries remains a serious concern for its economic development. Even though Sub-Saharan Africa has not been greatly affected by the impact of COVID as it has been the case of G20 countries, its forecasted economic growth shows a decline in its growth process. And one of the reasons its growth will decline is due to the lack of infrastructure and technology.

The share of Africa's working-age population is rising faster than any other region globally; 70 percent of the populace is under age 30.<sup>23</sup> It is projected that by 2034, it will have a larger potential workforce than either China or India.<sup>24</sup> Only accelerated infrastructure investment will harness this growth.<sup>25</sup> Currently, power is the lowest-hanging fruit in terms of return on investment—Sub-Saharan Africa is starved of electricity; two out of three people lack a domestic supply and there are many studies showing that a lack of basic infrastructure slashes productivity, as well as growth in gross domestic product.<sup>26</sup> The lack of electricity is not the only problem that Africans lack. The lack of infrastructure in education and healthcare remain an important impediment to Africa's development.

Education is the most viable and significant source of human capital for the African continent. Without education, the continent's ability to prosper will be quasi-impossible. Countries like Burkina Faso, Burundi, Sierra Leone, or Ethiopia all have literacy rates below 50 percent—in other words, over half of the population in these countries can neither read nor write.<sup>27</sup> Illiteracy and the lack of quality education are the main reason why Africa remains in poverty despite the abundance of both human and natural resources.<sup>28</sup> The lack of quality education is a fundamental problem to Africa's economic development because the measures to run school facilities were not adequately taken. As a matter of fact, public schools in Africa are generally cheaper and even free

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<sup>22</sup> *Tralac*, Ibid.

<sup>23</sup> Easen, Nick. "Africa: Lack of Infrastructure Leaves Millions in Poverty Despite Potential." *Raconteur*. (2018).

<sup>24</sup> *Raconteur*, Ibid.

<sup>25</sup> *Raconteur*, Ibid.

<sup>26</sup> *Raconteur*, Ibid.

<sup>27</sup> Editors, "Education in Africa: The Major Challenges." *AfricaW*. (2019).

<sup>28</sup> *AfricaW*, Ibid.

in most cases but most of these schools lack good teachers and school supplies.<sup>29</sup> African governments have completely failed not just the students but also the teachers to write home about.<sup>30</sup>

On the healthcare aspect, the economic development of Africa is lagging because there is an enormous lack of infrastructure in that sector. In fact, the three main issues that prevent the development of infrastructure in African healthcare systems are (1) inadequate human resources, (2) inadequate budgetary allocation of health, and (3) poor leadership and management.<sup>31</sup> Healthcare systems in Africa have difficulties responding to public health emergencies such as an outbreak of diseases leading to increase mortality and morbidity in many African countries.<sup>32</sup> This may be due to a lack of qualified health personnel in health facilities which may lead to poor health outcomes and ultimately impede achievements of national and global health goals.<sup>33</sup> Scarcity of funds for healthcare is a chronic problem with even the richest countries finding it increasingly difficult to keep up with rising healthcare costs, especially in the face of the ongoing economic downturn.<sup>34</sup> Many studies corroborate the fact that in about half of African countries, 40 percent or more of total healthcare expenditure is made up of out-of-pocket payments, which are the most regressive way of funding healthcare.<sup>35</sup> The average total healthcare expenditure in African countries stood at US\$ 135 per capita in 2010, but only a small fraction of the \$3150 spent on healthcare in an average high-income country.<sup>36</sup> These poor healthcare financing indices are prevalent in Africa despite several declarations signed by African heads of state, which among others include the Abuja Declaration of 2001 on increasing government funding for health, and the 2012 Tunis Declaration on value for money, sustainability, and accountability in the health sector.<sup>37</sup>

## CONCLUSION

The results of our autoregressive model showed that the economic growth of Sub-Saharan Africa will indeed decline within its growth process in the first years of the post-COVID era. We projected that the economic growth of the continent will be around 2.45 percent in 2025, falling from 4.08 percent in 2021. Our study suggested that there are two potential reasons which could explain the forthcoming decline of the economic growth of the continent. First, since a substantial portion of the African economy depends on the South African economy, there is a strong likelihood that the economic growth of the continent might be slow because the economic growth of South Africa will also decline for a given period of time during the first years of the post-COVID era. Second, it has been projected that the economic growth of Sub-Saharan Africa will slightly decline during

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<sup>29</sup> *AfricaW*, Ibid.

<sup>30</sup> *AfricaW*, Ibid.

<sup>31</sup> Oleribe, Obinna O; Momoh, Jenny; Uzochukwu, Benjamin SC; Mbofana, Francisco; Adebisi, Akin; Barbera, Thomas; Williams, Roger; Taylor-Robinson, Simon. "Identifying Key Challenges Facing Healthcare Systems in Africa and Potential Solutions." *International Journal of General Medicine*. (2019). Volume 12. pp. 395-403. DOI:10.2147/IJGM.S223882.

<sup>32</sup> Ibid. p. 400

<sup>33</sup> Ibid. p. 400

<sup>34</sup> Ibid. p. 400

<sup>35</sup> Ibid. p. 400

<sup>36</sup> Ibid. p. 400

<sup>37</sup> Ibid. p. 400

the first years of the post-COVID era because the lack of infrastructure and technology remains a serious predicament to Africa's economic development. Despite the technological progress that the continent has embarked on, its growth remains fragile because the basic infrastructures that should help to ameliorate the living standard of ordinary Africans are not set in place. We highly doubt that within these four forecasted years, technological innovation will suddenly and radically increase. We are not implying that it will not happen. It could potentially and possibly happen within these four forecasted years if, and only if, radical innovative ideas are being implemented at a fast pace to speed up the industrialization process of the continent.

Our analysis of the data shows a declining stationary economic growth in the forthcoming years to come. Once again, this stationary decline could be altered by human action within economic activities. The right measures and policies can radically change the trend of the GDP growth. Unless these radical innovative ideas are being implemented as we suggested, it is, for now, clear that the economic growth of Sub-Saharan Africa is set to decline in the years to come.

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