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# A SIGN-RESTRICTED VAR APPROACH TO ANALYZING THE SHOCKS EFFECTS OF THE COVID-19 ON THE NIGERIA'S SELECTED MACROECONOMIC VARIABLES

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### Abstract

It is utterly evident that the Corona Virus (COVID-19) global pandemic had wrecked a great havoc on the global economy. Nigeria is not an isolation looking at the globally ravaging and devastating effect of the pandemic on the global economy. This paper explores within the framework of a sign restricted structural VAR, propagation of perturbations among the Nigeria's macroeconomic indicators namely, GDP, inflation and the COVID-19 using the number of cases recorded in the country as a proxy. The results of the impulse response functions revealed evidence of transmission of shocks from the COVID-19 variable to GDP and inflation. The response of GDP to a one unit standard deviation shock to the COVID-19 has been found to be negative during the period horizon, while the response of inflation to a unit shock to the COVID-19 was positive signifying the price-trigger effect of the pandemic on goods and services. The COVID-19 impulse response function was positive from the beginning of the period horizon but thereafter the impulse response became negative which suggests that the pandemic has had a negative effect on GDP and a positive effect on inflation in Nigeria. The results point to the need for taking stiffer macroeconomic measures by the authorities of the country in assuaging the effects of the pandemic on prices as well as output, this would help in propelling and sustaining growth.

Keywords COVID-19 Macroeconomic Indicators Economic Growth Sign-restricted structural VAR

**JEL Classification** E66, E69

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# 1. Introduction

Since the year 2019 to date, the world has been faced with a highly infectious disease called the Coronavirus (COVID-19), which is caused mainly by a harshly acute respiratory syndrome virus. The eruption of this disease has changed both the social, financial and economic realities globally (Acemoğlu et al., 2020; Álvarezetal,

2020; IMF, 2020). A large number of countries around the world were reported to have been ravaged by this contagious disease. It was originated from Wuhan, China, in December 2019 and thereafter spread rapidly worldwide thereby creating one of the biggest health and economic crisis in the history of the Humankind. This was construed as the global pandemic on 11<sup>th</sup>March, 2020 by the World Health Organization (WHO). As of 12th December, 2021, nearly269 million people were reportedly infected with the disease, and nearly 5.3 million people had reportedly died worldwide (WHO, 2021). The Medical Experts had recommended various preventive measures such as social distancing, restrictions on mobility, frequent washing/sanitizing of hands and isolation procedures to control the spread of the pandemic. A multitude of nations had enforced lockdown as a procedure to check the disease. The pandemic had led to a prolonged financial and economic crisis that affected the lives of nearly every human being on the earth. The shut-down of the economy coupled with their restrictions that were imposed on the social movement, forced the economic activities to operate on a limited scale. This unprecedented event has had a substantial negative effect on economic growth and development of nations across the globe. The unemployment rate had skyrocketed, and businesses were forced to shut down due to liquidity crisis, and the wellbeing of people had been affected on a massive scale.

In Nigeria, the first case of theCovid-19 was detected / confirmed on 27th February 2020 and by 12<sup>th</sup> December, 2021, 217,481 people had been affected by the pandemic and 2,981 people had died in the country, while the number of those who had been successfully treated and discharged rose to 207,746. The government took various steps to curtail the spread of the pandemic by using various measures which include locking down the country for nearly two months, except for the emergency social services, the government shut-down all activities, services and, restricted social gathering. The Security Agencies were deployed to assist the civil administration in minimizing the spread of the virus. Journeys, commercial activities, educational institutions, and other social activities were also shut-down

during the period. The pandemic had mostly affected lower and the middle-class in Nigeria.

The measures taken by various governments in the world had severely affected economic activities around the globe. For instance, Albu (2020) noticed that the total GDP of European union in the first scenario fell down by -9.3% in 2020, while for the second and third scenarios the GDP plummeted by -7.4% and -7.1%, which corresponds to 39.9% and 38.3% global damages the pandemic wrecked on GDP at the peak period of the pandemic. In Nigeria for instance, the real GDP grew by -3.6% in the third quarter of 2020even though there was improvement in the real GDP growth in the third quarter of the 2021 as it grew by 4.0% (NBS 2021). The pandemic had also led to high level of unemployment and inflation due to the imposition of lockdown, which caused unemployment rate rise by 33.3%, which at the time deemed the highest and the second highest rate in the world. The lockdown enabled the government to prepare and distribute the essential equipment/relief materials across the country. The health department and some private organizations constructed temporary hospitals in most areas in the country, and the government allocated special funds to assuage the effects of the pandemic. Protective gears, masks, hand sanitizers, etc., were imported, produced and distributed on a largescale. Rigorous medical diagnosis was conducted and the testing kits were developed distributed locally to help identify and isolate the affected persons. This prompted the government to borrow money and invest in the health sector which has had effect on debt and exchange rate in the country. This therefore. sets to explore paper the contemporaneous relationship between the COVID-19and Nigeria's macroeconomic variables, namely inflation, and GDP using monthly data from 2017m01 to 2021m09. The aim is primarily to examine and analyze the effect of the pandemic on these variables which is achieved through the impulse response analysis purportedly generated by the use of a sign restricted structural VAR. The contributions of the paper can be gleaned from two strands. First, the paper uses the sign rather than mere zero exclusion restrictions in identifying the macroeconomic shocks due to the pandemic. Two, the paper enriches the literature by using up to date information and making an insight into the recent effects of the pandemic on the Nigerian macro economy.

# 2. Literature review

Assessing global economic growth in the realtime is the key role of macroeconomists who are mainly preoccupied with monitoring global economic problems. Empirical studies on economic effects of the COVID - 19 on the global economy are one of the principal issues in International Macroeconomics, Macroeconometrics and Finance today. For instance, Albu (2020) have estimated the parameters of the logistic model for the European Union, obtaining in the first scenario a GDP slowdown of -9.3% in 2020, while for the second and third scenarios the GDP plummeted by -7.4% and -7.1%, which corresponds to 39.9% and 38.3% global damages the pandemic wrecked on GDP at the peak period of the pandemic. Nevertheless, Iuga and Mihalciuc (2020) have analyzed the influence of macroeconomic indicators on economic growth for the European Union (EU) member countries in the Central and Eastern Europe from 2001Q1–2020 Q2 by using models same variables two with and coefficients, six for the first model and seven for the second model with the addition of coronavirus cases which changed the behavior of the independent variables. They found that the (COVID-19) variable has affected the economic indicators of the countries as it engendered a change in certain macroeconomic indicators with a direct influence on economic growth.

McKibbin and Fernando (2020) have examined the global macroeconomic impact of the COVID-19 by using seven plausible scenarios of the pandemic and the macroeconomic outcomes using a global hybrid Dynamic Stochastic General Equilibrium /Computable General Equilibrium (DSGE/CGE) model. The results revealed that even a contained outbreak had significantly impacted on the global economy in the short-run. The economic costs could have been significantly avoided with greater investment in public health systems in all the economies, particularly in economies where healthcare systems are less developed and population density is high. A study by Idris and Oruonye (2020) examined the social and economic impact of the covid-19 in Nigeria taking into cognizance its effects on certain critical macroeconomic indicators. Their findings revealed that virtually all essential macroeconomic indicators were grossly affected with tax, remittances and employment exhibiting severe consequences. Mooreet al (2021) have assessed impact of the COVID-19 pandemic on the global economy; in the study, emphasis was mainly placed on poverty alleviation and economic growth for panel of 170 countries. The study found that the pandemic has a significant long-run impact on economic growth.

Apergis and Apergis (2021) explored impact of the COVID-19 on economic growth, evidence from a Bayesian Panel Vector Autoregressive (BPVAR) model of the Organization of Economic Cooperation and Development (OECD) countries, spanning the period March 2020 to January 2021. The findings documented that the COVID-19 shock had exerted a strong negative effect on industrial production. Oravský et al (2020) examined the ability of selected European Countries to face the impending economic crisis as caused by the COVID-19 in the context of the global economic crisis of 2008. The results showed that despite consolidation measures, the countries have

failed to return to pre-economic level which has had a negative impact on their readiness to face the lingering economic crisis. Hridoy et al (2021) have evaluated impact of the COVID -19 pandemic on economic growth in Bangladesh. They found that the COVID-19 pandemic has had significant impact on multitude of economic indicators of Bangladesh.

Nevertheless, it is worth noting that from the empirical literature reviewed so far, only Idris and Oruonye (2020) have sought to examine social and economic impact of the covid-19 in Nigeria, a huge preponderance of the empirical studies on this topic have mainly focused on developed countries, with plentiful of them using qualitative methods of analysis of the subject matter. Therefore, as distinct these studies, this paper uses one of the recent advancements in the econometric time series techniques, namely a structural vector autoregressive (SVAR) model with sign restrictions as an identification procedure as it stands out nowadays as an indispensably popular tool for macroeconomic analysis which can easily identify structural shocks. To the best knowledge of the Authors, this paper is the first to adopt this technique in analyzing the effects of the COVID-19 on Nigeria's macroeconomic indicators.

# 3. Methodology

This section describes the data used and its sources and goes ahead to discuss the econometric technique used in the paper.

# 3.1 Data and its Sources

The data used for the purpose of this paper is monthly and covers the period 2017m01-2021m09. The data on gross domestic product (GDP) and inflation (INF) was obtained from the Central Bank of Nigeria Statistical Data base, while data on the COVID-19 based on the cases recorded during the sample period was obtained from the National Centre for Disease Control (NCDC).

# 3.2 Unit Root Testing

Prior to estimating the sign-restricted VAR model, unit root tests with breaks were employed to examine order of integration of the series in order to avoid misspecification. Perron (1989) argued that in the presence of a structural break, the standard ADF tests are biased towards the non-rejection of the null hypothesis. The tests are the Augmented Dickey Fuller tests with breaks based on the following equation:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \mu_1 D_P + \mu_2 D_L + \sum_{i=1}^{P} \beta_i \Delta y_{t-i} + \varepsilon_t$$
 1

Where  $D_P$  and  $D_L$  are pulse and level dummies respectively, the formulation of the null and alternative hypothesis for the test is as follows:

 $H_0$ : The series has unit root with break

 $H_1$ : The series has no unit root

### 3.3 Model

Nowadays, sign restricted VARs (SRVARs) are becoming popular and can be considered as an indispensable tool for macroeconomic analysis. The traditional structural VARs are identified with the exclusion restriction which is sometimes difficult to justify by economic theory. In contrast, SRVARs can easily identify structural shocks since in many cases economic theory only offers guidance on the sign of structural impulse responses on impact. Due to these statistical advantages of this modeling technique, this paper adopts it in analyzing macroeconomic shocks due to the COVID-19 on two macroeconomic variables of Nigeria namely, gross domestic product (GDP) and inflation. Following Uhlig (2005), the model is specified our model as:

2

 $Y_t = B_1 Y_{t-1} + B_2 Y_{t-2} + \Lambda + B_1 Y_{t-1} + u_t$ 

where  $Y_t$  is an  $m \times n$  vector of data at date t=1 $l, ..., T, B_i$  are coefficient matrices of size  $m \times m$ and  $u_t$  is the one-step ahead prediction vector of errors / shockswith variance-covariance matrix  $\Sigma$ . With a total of *m* fundamental innovations, which are mutually independent and normalized to have a variance of unity (1); they can therefore be represented by a vector v of order  $m \times 1$  with  $E[vv'] = I_m$ . It is noteworthy that independence of the innovations is an appealing assumption invoked in much of the VAR literature. The primary aim is to find a matrix A such that  $u_t = Av_t$ such that the  $j^{th}$  column of A represents the immediate impact on all variables of the *j*<sup>th</sup>fundamental innovation, one standard error in size. The only restriction onmatrixA thus far. emerges from the covariance structure:  $\sum = E[u_t u_t] = AE[vv]A = AA$ . It is noteworthy that the VAR has been reduced to its reduced form upon which the estimation is based prior to identifying the model. The reduced form VAR takes the following form:

$$\widetilde{Y}_{t} = \widetilde{c} + \widetilde{B}Y_{t-1} + \widetilde{A}\varepsilon_{t} \qquad 3$$

Each impulse response at horizon k=0, 1, ... to the  $j^{th}$  shock, one standard deviation in size and of positive sign is given by:

$$\widetilde{r}_{k} = \widetilde{B}^{k} \widetilde{A} e_{i} \qquad 4$$

Where  $e_j$  is a vector of the same length as  $\varepsilon$  with only zero entries, except 1 in entry j.From  $\tilde{r}_k$ , it is now easy to extract the impulse responses of the individual time series. Sign restrictions are then typically imposed on entries in  $\tilde{r}_k$  at various horizons k.

### 3.4 Identification

Fundamentally, what distinguishes structural VARs with sign restrictionfrom standard VARs is identification. Identification in SVARS is

achieved by imposing restrictions on the parameters of interest which usually derives from the underlying economic theory. The aim primarily is to recover the structural shocks from the reduced form shocks by invoking sensible economic interpretations in the process of imposing the restrictions. In this paper the sign restriction vector of the model is restricted as follows:

$$v_t = (-3, +2, -1) \equiv (-GDP, +INF, -COVID)$$
 5

The impulses on GDP were restricted to be negative due to a priori expectation that the effect of the COVID-19 on Nigeria's GDP was negative at the period of the pandemic. The sign on the impulse response function for inflation was restricted to be positive which is theoretically sensible given the soaring up of prices of goods and services due to supply shortage at the period. Nonetheless, the sign on the impulses / shocks due to the COVID-19 variable was restricted to be negative due to the fact that the pandemic has had negative impact on economic outcomes.

# 4. Results and Discussion

This section begins with the descriptive statistics of the series which gives an insight into the distributional properties of the series, unit root tests with breaks were also conducted to avoid mis-specification and running into spurious regression.

### 4.1 Descriptive Statistics

The usual preliminary statistical analysis of any data is the descriptive statistics. Therefore, Table I presents the results of descriptivestatistics of the series. The variables are LGDP, INF and COVID. The results show that the COVID-19variable has the highest mean of 3610.158, followed by INF with14.51937 then LGDP with 10.43948 respectively. The maximum and minimum valuesof the variables

indicate that LGDP has a minimum of 9.068330 and a maximum of 16.52608 with skewness of 1.866789 and a Kurtosis of 4.503751 respectively. INF and COVID have a minimum of 11.26792 and 0.000000 with a maximum of 18.17000 and 43635.00 respectively. The skewness of INF and COVID are 0.011915 and 3.002518 with a Kurtosis of 1.398810 and 13.29543 respectively.

Table 1 Descriptive Statistics

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
LGDP	10.43948	9.364545	16.52608	9.068330	2.624101	1.866789	4.503751
INF	14.51937	14.37067	18.17000	11.26792	2.468991	0.011915	1.398810
COVID	3610.158	0.000000	43635.00	0.000000	7960.093	3.002518	13.29543

20

18

16

14

12

10

. .

2017

IV I II

Sources: Researchers' computation 2023

# 4.2 Time

# Series Plots

Before conducting the unit root tests there is the need to visualize and examine plots of the series with a view to preliminarily identifying non-stationarity, outliers, breaks and tendency for a tentative nonlinearity in the series. From Figure

1 it can be observed that all the series have sign of tentative breaks during the COVID - 19 pandemic in Nigeria from 2020 to 2021; it is noteworthy that Nigeria started witnessing the pandemic in the year 2020.

INF

II III IV

2019

1

2020

1

2021

I.

2018



Figure 1. Breaks during COVID – 19 pandemic Sources: Researchers' computation (2023)

# 4.3 Unit Root Tests

After plotting the series the next conventional practice in time series analysis is to test for unit root in the series. Given the advent of the pandemic, and tentative visualization of the series' plots we conduct unit root tests with breaks to statistically account for theanticipated breaks. Therefore the Augmented Dickey Fuller (ADF) unit root tests with breaks rather than ordinary unit root tests that do not account for breaks were considered in this paper. Table 2 reports the results of ADF unit root tests with break with intercept and the results indicate that all the variables are stationary at level with different break dates as indicated in the results.

Table 2. ADF Unit Root Tests with Break	ADF with Break at Level				
Note: ** indicate statistically	Variables	t-Statistic	Prob.*	Break Date	
significant at 5% level	LGDP	-6.363234**	< 0.01	2020M11	
Sources: Researchers'	INF	-5.71311**	0.021	2020M02	
computation (2023)	COVID	-9.956457**	< 0.01	2020M04	

# 4.4 Model

# Estimation

The order of integration of the series from the unit root tests reveal that the series are all I(0) processes which validates using vector autoregressive (VAR) model in levels. Hence, we estimate the reduced form VAR with all variables in level. However, it is noteworthy that prior to the estimation of the VAR a lag length

criteria test was carried out in order to choose optimal lag to include in the estimation and, as such, 5 lags were chosen. But to check for serial correlation which was encountered in the results after estimating the model, eleven (11) lags were used and the results were reported in tables 3 and 4 respectively.

Table 3 Lag Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-767.7798	NA	1.50e+09	29.64538	29.75795	29.68854
1	-572.3912	360.7175	1159926.	22.47658	22.92687	22.64921
2	-509.7319	108.4488	147866.6	20.41276	21.20077	20.71487
3	-494.0687	25.30199	115544.0	20.15649	21.28221	20.58806
4	-483.6368	15.64795	111330.7	20.10141	21.56485	20.66246
5	-451.7723	44.12002*	47581.22*	19.22201*	21.02316*	19.91253*

Sources: Researchers' computation (2023)

It can be observed from Table 3 above that the lag selection criteria has automatically chosen 5 lags to be used for estimating the model, but because of the serial correlation problem that was encountered the model was estimated with

11 lags although that could be at the expense of losing degrees of freedom but serial correlation is deemed as more statistically worrisome than losing degrees of freedom.

Lag	LRE* stat	Df	Prob.	Rao F-stat	Df	Prob.
1	13.81823	9	0.1289	1.814699	(9, 17.2)	0.1379
2	7.891984	9	0.5451	0.886987	(9, 17.2)	0.5554
3	3.750820	9	0.9270	0.379623	(9, 17.2)	0.9293
4	8.825642	9	0.4535	1.016099	(9, 17.2)	0.4648
5	7.389553	9	0.5966	0.819882	(9, 17.2)	0.6063
6	5.389290	9	0.7991	0.568315	(9, 17.2)	0.8048
7	7.241506	9	0.6120	0.800417	(9, 17.2)	0.6214
8	9.221158	9	0.4171	1.072575	(9, 17.2)	0.4287
9	7.974820	9	0.5367	0.898208	(9, 17.2)	0.5472
10	2.060537	9	0.9905	0.200008	(9, 17.2)	0.9908
11	16.48081	9	0.0575	2.326273	(9, 17.2)	0.0634
12	26.48901	9	0.0017	4.961952	(9, 17.2)	0.0022

Table 4 VAR Residual Serial Correlation LM Tests

Sources: Researchers' computation 2023

Since the post estimation of the VAR result indicated no serial correlation among the residuals, the primary aim is to estimate a sign restricted Structural VAR modelin order to achieve our objective. Hence, we have estimated the SVAR model based on sign restriction identification scheme and generated the impulse responses and SVAR forecast error variance decomposition. The results of the sign restricted SVAR impulse a response is depicted in figure 2 below:



It is noteworthy that the impulse responses were generated for 20 period horizons due to the size of the sample. The impulses on the logarithm of gross domestic product were restricted to be

negative because it is a common knowledge in the literature that the pandemic has had a negative effect on the economic growth of nations across the globe. The impulses on inflation were restricted to be positive due to the fact that the pandemic had caused a scandalous surge in the prices of goods and services due to enforced measures of restrictions of movements that were imposed and, consequent shortage of supply during the period. However, the impulses on the COVID-19 variable were restricted to be negative owing to negative effect of the pandemic on macroeconomic variables. The Figure 2 shows the results of the sign restricted SVAR impulse responsesbased on these theoretical restrictions we have earlier outlined. It can be observed that the response of LGDP (economic growth) to a 1 unit standard deviation shock to the COVID-19was negative which signifies the retarding effect the pandemic has had on Nigeria's economic growth. The response of inflation to a 1 unit standard

Table 5 Variance Decomposition of LGDP

deviation shock to the pandemic was positive as revealed by a sharp spike in the graph which corresponds to a very sharp rise in prices over the period horizon of the pandemic.Nevertheless, the COVID-19 impulse response function was positive from the beginning of the period horizon but thereafter the impulse response became negative corroborating further the fact that the pandemic has a negative effect on GDP and a positive effect on inflation in Nigeria respectively.

It is noteworthy that impulse response functions trace the effects of a shock to one endogenous variable on the other variables in the SVAR; while, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the SVAR. Table 5 presents the SVAR Variance Decomposition with particular emphasis on the proportions of forecast error in LGDP (economic growth) accounted by the variables under study.

Period	S.E.	LGDP	INF	COVID
1	0.078972	100.0000	0.000000	0.000000
2	0.136427	46.30525	1.013126	52.68162
3	0.202100	21.16172	0.496952	78.34132
4	0.252185	16.90057	0.637494	82.46194
5	0.293043	33.32051	1.578491	65.10100
6	0.350461	47.68678	1.364453	50.94877
7	0.430629	48.56174	0.924369	50.51389
8	0.487107	43.35034	1.121992	55.52767
9	0.770386	21.75981	1.968787	76.27141
10	0.823518	19.80779	10.58895	69.60326

Sources: Researchers' computation (2023)

The results of SVAR Variance Decomposition of LGDP in Table 5 reveals that in the first period economic growth (LGDP) accounts for 100% variation to itself and less than 1% throughout the remaining periods, with COVID accounting for more than 78% in the third period, 50% in the sixth period, and more than 76% in the ninth period respectively. Inflation (INF) accounts for less than 1% variation of LGDP in the third period, less than 1.5% in the

sixth period and 2% in the ninth period respectively.

The Granger causality test results are reported in Table 6. The results show that there exists a bi-directional causality among LGDP, INF and the COVID-19 in Nigeria, running back and forth among the variables as the null hypothesis of no causality is rejected at the 5% level of significance.

Table 6 VAR Granger Causality Tests

Dependent variable: LGDP							
Excluded	Chi-sq	Df	Prob.				
INF	98.84763	11	0.0000				
COVID	3039.576	11	0.0000				
All 6844.065 22 0.0000							
Sources: Researchers' computation (2023)							

Sources: Researchers' computation (2023)

# **5.** Conclusion and Recommendations

The paper has explored the effect of the COVID-19 on macroeconomic indicators and economic growth in Nigeria using a monthly data from 2017M1 to 2020M12 within the framework of a sign restricted structural VAR. Propagation of the perturbations / shocks among the Nigeria's macroeconomic indicators namely GDP, inflation and the COVID-19 has been conscientiously examined and analyzed in this paper using the impulse response functions. The results of the impulse response functions and variance decomposition revealed evidence of transmission of shocks from the COVID -19 variable to logarithm of gross domestic product (LGDP) and inflation (INF). In colloquial terms, Nigeria's GDP has responded negatively to COVID-19, while inflation responded positively to the shock to the COVID-19.

The results from the Granger causality test revealed a bi-directional causality among LGDP, INF and the COVID-19 in Nigeria, running twoway among the variables as the null hypothesis of no causality was rejected at 5% level of significance. Hence, based on the results, it can be inferred that stiffer measures can be taken by

the authorities of the country to mitigate the effects of the pandemic in order to propel and sustain growth.

### **References:**

- Acemoglu, D. (2020). Remaking the post-COVID world. Sixth Richard Goode Lecture, 4, 2020.
- Albu, L. L. (2020). How much will the Coronavirus pandemic expand?
- Alvarez, F., Argente, D. and Lippi, F. (2020). A simple planning problem for COVID-19 lockdown. Unpublished, University of Chicago, Pennsylvania State University, LUISS and Einaudi Institute.
- Apergis, E., & Apergis, N. (2021). The impact of COVID-19 on economic growth: evidence from a Bayesian Panel Vector Autoregressive (BPVAR) model. Applied economics, 53(58), 6739-6751.
- Asteriou, D., & Hall, S. G. (2011). Applied econometrics second edition. Hampshire: Palgrave Macmillan.
- Ender, J. H. (2010). On compressive sensing applied to radar. Signal Processing, 90(5), 1402-1414.
- Hridoy, R. M., Mohsin, N., & Alam, M. A. (2021). Implications of TPM in Domestic Based Ready Made Garments Industry in Bangladesh during Corona pandemic: A Case Study. In 11th Annual International Conference on Industrial Engineering and Operations Management, IEOM 2021 (pp. 5455-5463).
- Idris, M., & Oruonye, E. (2020). Socioeconomic Impact of COVID-19 in oil exporting countries: An analytical review of the macroeconomic indicators in Nigeria. International Journal of World Policy and Development Studies, 6(5), 44-50.
- Iuga, I. C., & Mihalciuc, A. (2020). Major crises of the XXIst century and impact on economic growth. Sustainability, 12(22), 9373.

- McKibbin, W. J., & Fernando, R. (2020). Global macroeconomic scenarios of the COVID-19 pandemic.
- McKibbin, W., & Vines, D. (2020). Global macroeconomic cooperation in response to the COVID-19 pandemic: a roadmap for the G20 and the IMF. Oxford Review of Economic Policy, 36(Supplement\_1), S297-S337.
- Moore, S. E., Wierenga, K. L., Prince, D. M., Gillani, B., & Mintz, L. J. (2021).
  Disproportionate impact of the COVID-19 pandemic on perceived social support, mental health and somatic symptoms in sexual and gender minority populations. *Journal of homosexuality*, 68(4), 577-591.

National Bureau of Statistic (2021) Report

Nelson, C. R. and Plosser, C. I. (1982) Trends and random walks in macroeconomic time series, Journul of Monetary Economics, 10, 139-62. Nigeria Centre for Disease Control Various Reports

- Oravský, R., Tóth, P., & Bánociová, A. (2020). The ability of selected European countries to face the impending economic crisis caused by COVID-19 in the context of the global economic crisis of 2008. *Journal of Risk and Financial Management*, *13*(8), 179.
- Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica: journal of the Econometric Society*, 1361-1401.
- WHO (2021) Classification of Tumours Editorial Board. World Health Organization Classification of Tumours of the Central Nervous System. 5th ed. Lyon: International Agency for Research on Cancer;
- World Health Organization. (2020). HIV/AIDs: key facts. Geneva, Switzerland: World Health Organization.
- World Health Organization (WHO), 2021 Report