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Investigating The Effect of the COVID-19 Pandemic on the Nigerian Economy: An Autoregressive Distribution Lags (ARDL) Perspective

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Abstract

COVID-19 has had a devastating impact on the global economy, particularly in Nigeria. A study focused on the long-term and short-term effects of COVID-19 on Nigeria's GDP using macroeconomic variables. Weekly data from the CBN statistical bulletin (2021-2022) and the Johansen co-integration test revealed a significant negative impact of COVID-19 on GDP, implying reduced economic growth in the long run ($p<0.05$). The study recommends stringent disease management and financial support for private investors to counteract COVID-19's adverse economic effects.

Keywords: COVID-19, Economy, Pandemic, ARDL, Long run.

INTRODUCTION

Pandemics are widespread disease outbreaks resulting from human-to-human infection transmission. Throughout history, notable pandemics include the Spanish Flu, Hong Kong Flu, SARS, H7N9, Ebola, Zika, and COVID-19 (WHO, 2020; Rewar et al., 2015). The term "pandemic" encompasses key features such as extensive geographic reach, disease spread, novelty, severity, high attack rates, explosiveness, minimal population immunity, infectiousness, and contagiousness, aiding in a comprehensive understanding of the concept. Pandemics negatively impact health, economies, societies, and the security of global communities, leading to considerable political and social disruption. COVID-19, a coronavirus, has caused worldwide tension and devastation, prompting lockdowns and the shutdown of businesses across all sectors globally. The pandemic has affected every country, profoundly impacting people's lives and economies worldwide. COVID-19 is recognized as a respiratory illness and at the same time a deadly disease that is capable of spreading from person to person through indirect, direct or close contact with an infected person through infected secretions such as saliva and respiratory secretions, or through their respiratory

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droplet which is expelled when an infected person coughs, sneezes, talks or sings (WHO, 2020, 2022). This virus that causes COVID-19 is a novel virus that was first identified during an investigation into an outbreak in Wuhan, China (Otache, 2020). The impact of COVID-19 cannot be overemphasized especially in the economic growth of nations.

Several researchers have worked on the impact of Covid 19 pandemic and its economic consequence on economic growth; in the financial market of Nigeria, China and the USA., on its outbreak on the Nigerian Stock Exchange's performance using Evidence from GARCH Models, some used dynamic ordinary least square and many other statistical tests. (Farabiyi and Asongu, 2020, Sansa, 2020, Inegbedion, 2021, Adenomon *et al*., 2022, Adenike, 2022 and Adenomon & Idowu, 2023).

MATERIALS AND METHODS

Data Source

This study used weekly time series data spanning from 2020 – 2021, which includes gross domestic product (GDP), COVID-19 (COV), Inflation (INF), and Exchange rate (EXH) were sourced from the Central Bank of Nigeria.

Model Specification

Autoregressive Distributed Lag Model

The Autoregressive Distributed Lag (ARDL) model, as developed by Pesaran, Shin, and Smith (2001), is advantageous when dealing with variables of different orders of integration (I(0), I(1), or a combination) and is robust for identifying a single long-run relationship in small sample sizes. The F-statistic (Wald test) is employed to detect the long-run relationship, and it is considered established when the F-statistic exceeds the critical value band. A key advantage of the ARDL model is its ability to identify multiple co-integrating vectors. However, it may fail in the presence of an integrated stochastic trend of I(2). In summary, the ARDL model is specified as follows:

$$\emptyset(\mathrm{L})y_i = \varphi + \theta_1(\mathrm{L})x_{1t} + \theta_2(\mathrm{L})x_{2t} + \theta_3(\mathrm{L})x_{3t} + \cdots \ldots \ldots + \theta_k(\mathrm{L})x_{kt} + \mu_i \quad (2.1)$$

Unit Root Test

The unit root test assesses the level of integration of individual series, aiming to determine their stationarity. In essence, it examines whether variables under consideration exhibit stationarity. If a series has a unit root, it indicates non-stationarity for that series. Several procedures have been developed for the test of order of integration including the choice for this study: Augmented Dickey-Fuller (ADF) test due to Dickey and Fuller (1981), and the Phillip-Perron (PP) due to Phillips and Perron (1987, 1988). Thus, in this research, the Augmented Dickey-Fuller test was utilized. Therefore, the hypothesis suggesting the presence of a unit root in the series was rejected when the Augmented Dickey-Fuller statistic exceeded the ADF-critical value at 5%. If the null hypothesis of non-stationarity at the level was not rejected, the study proceeded to test the variables in the first difference and subsequent steps. Let X represent any variable, and the Augmented Dickey-Fuller (ADF) model can be defined as follows:

$$\Delta X_t = \beta_0 + \beta_1 X_{t-1} + \sum_{i-1}^{m} \beta \Delta X_t + \varepsilon_i \quad (2.2)$$

$$\Delta X_t = \beta_0 + \beta_1 X_{t-1} + \varepsilon_i \quad (2.3)$$

where:
X is a time series,
t is a linear time trend,

Δ is the first difference operator,
β_0 is the constant,
$\varepsilon_i$is a pure white noise error term,
m is the optimum number of lags in the dependent variable.
The difference between equation (1) and (2) is that the first equation includes just drift. However, the second equation includes both drift and linear time trends.

$$X_t = \beta_0 + \beta_1 X_{t-1} + \sum_{m-1}^{m} \beta \Delta X_t + \delta_1 + \varepsilon_i \qquad 2.4$$

RESULTS AND DISCUSSION

Fig. 1 shows that in the fourth week of February 2020, Nigeria recorded its first case of Covid19 virus. Since then the trend has maintained a weekly increase of COVID-19 till the 26th week which was around November 2020 thereafter the curve started to flatten and continued till the first of December 2020. Between the periods of January to February 2021, COVID-19 cases surged again but began to drop from February to July 2021.

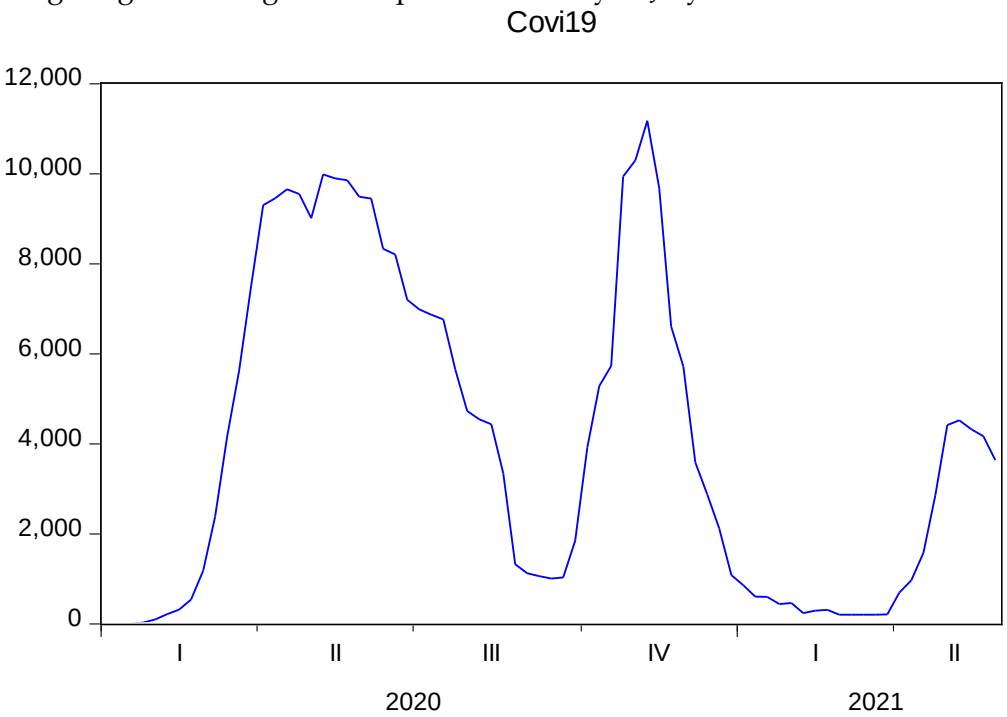

Fig. 1: *Trend of Reported Cases of COVID-19 in Nigeria from the last week of February 2020 to the second week of September 2021.*

Unit Root

This involves examining the stationarity of individual variables through Augmented Dickey-Fuller (ADF) tests to identify the presence of unit roots in each time series. The outcomes of both ADF tests are presented in the following table 1.

Table 1: Unit Root Test

	Critical Value					
VAR	1% level	5% level	10% level	ADF statistic	p-value	Order of Integration
GDP	-3.68919	-2.97185	-2.62512	-4.35859	0.0019	I(1)
COV	-3.78803	-3.01236	-2.64612	-3.35844	0.0249	I(1)
UEM	-3.78803	-3.01236	-2.64612	-3.98212	0.0066	I(1)
INF	-3.68919	-2.97185	-2.62512	-4.35859	0.0019	I(1)
EXCH	-3.71146	-2.98104	-2.62991	-7.27958	0.0000	I(1)

The results from Table 1 strongly indicate that all the considered variables were not stationary at their initial levels but achieved stationarity after being differenced once. This conclusion was drawn by comparing the absolute values of the observed ADF test statistics with the critical values (also in absolute terms) at the 1%, 5%, and 10% significance levels. Consequently, the null hypothesis suggesting a unit root in the series was rejected, leading to the conclusion that there is no presence of a unit root in the variables at the first difference. Consequently, all variables are integrated of order one, I(1), meeting the prerequisite for the Vector Error Correction Model. Thus, it is essential to subject the series to the Johansen co-integration test to ascertain if there is evidence of a long-run relationship among the variables.

ARDL Model

Table 2: Estimation Result of ARDL Model for Short Run

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
COV(-1)	-0.430197	0.187864	-2.289935	0.0409
UEM(-1)	-0.432794	0.129170	-3.350588	0.0058
EXR(-1)	-0.187490	0.072545	2.584474	0.0239
EXR(-2)	-0.144056	0.060705	-2.373074	0.0352
INF	-0.155282	0.082589	1.880181	0.0846
INF(-2)	-0.166927	0.086008	1.940825	0.0761
C	16.75185	9.300502	1.801177	0.0968
R-squared	0.861627	Mean dependent var		11.62288
Adjusted R-squared	0.642536	S.D. dependent var		6.310150
S.E. of regression	3.772732	Akaike info criterion		5.762647
Sum squared resid	170.8021	Schwarz criterion		6.678732
Log likelihood	-72.20235	Hannan-Quinn criter.		6.066303
F-statistic	3.932736	Durbin-Watson stat		2.452447
Prob(F-statistic)	0.009476			

Table 2 presents the results of the short-run ARDL model, demonstrating significant negative relationships between GDP and COVID-19, Unemployment, and Exchange Rate at lag 1. Inflation Rate, though negatively associated, is not statistically significant at the 5% level. The model explains 86.1% of GDP variation (R-square = 0.861627), indicating a good fit and the Dublin Watson statistics value of 2.452447 suggests no autocorrelation issues in the short-run ARDL model.

Table 3: ARDL Co-integration Test (Pesaran)

Pesaran F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
Pesaran F-statistic	6.602666	10%	2.26	3.35
K	5	5%	2.62	3.79
		2.5%	2.96	4.18
		1%	3.41	4.68

Table 3 shows the ARDL co-integration test results. The Pesaran F-statistic (6.602666) significantly exceeds the 5% critical value (3.79), indicating strong evidence to reject the null hypothesis of no co-integration. This implies the presence of co-integration among variables like COVID-19 (COV), Exchange Rate (GEX), and Inflation Rate (INF). Consequently, further analysis through an error correction model is needed to evaluate the significance of the long-run relationship among these variables.

Table 4: Estimation Result of ARDL Model for Long Run

Levels Equation
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
COV	-0.204323	0.05 126	-3.463101	0.0051
UEM	-0.449308	0.201453	-2.230336	0.0456
EXCH	-1.545262	0.626604	-2.466090	0.0297
INF	-0.000103	4.92E-05	-2.098975	0.0576

Table 4 displays the ARDL Bounds Test results for long-run relationships. Using AIC with a maximum lag of 2, it reveals a negative long-run association between COVID-19 and GDP (β=-0.204323, p=0.0051). Unemployment significantly impacts GDP negatively in the long run (p=0.0456), while Exchange Rate has a significant impact (p=0.0297). The inflation rate's long-run impact on GDP is insignificant at the 5% level (p=0.0576) but becomes significant at the 10% level.

Diagnostic Test for ARDL Model

To diagnose the ARDL Model, the Breusch-Godfrey Serial Correlation LM Test was employed to identify potential autocorrelation issues in the estimated model.

Table 6: Breusch-Godfrey Serial Correlation LM Test

F-statistic	1.559151	Prob. F(2,17)	0.2389
Obs*R-squared	5.114944	Prob. Chi-Square(2)	0.0635

Table 6, with an F-statistic of 1.559151 and a probability of 0.2389, indicates that the null hypothesis of no serial correlation in the ARDL model is not rejected. Therefore, the model is free from autocorrelation problems.

CONCLUSION

The study concluded that the COVID-19 pandemic significantly negatively impacted Nigeria's GDP both in the short and long run, with unemployment and exchange rate fluctuations showing substantial adverse effects, while the inflation rate's impact was not statistically significant at the 5% level. These findings align with previous research by Farabiyi and Asongu (2020), Sansa (2020), and Inegbedion (2021), which reported similar negative effects of the pandemic on financial markets and economic indicators in Nigeria. The robustness of the results was confirmed by the absence of serial correlation, as indicated by the Breusch-Godfrey Serial Correlation LM Test. Consistent with studies by Adenomon et al. (2022) and Adenike (2022), the negative relationship between COVID-19 and GDP underscores the need for stringent disease management and financial support for private

investors to mitigate the pandemic's economic impact. These measures, as recommended by Otache (2020), are crucial for fostering economic recovery and sustainable growth in Nigeria.

REFERENCES

Adenike, T.E (2022). The Impact of COVID-19 on the Nigerian Financial Market Performance *J.Sus. Dev.Afr.* 24, 111-122

Adenomon, M.O.; Maijamaa, B. and John, D.O. (2022). The Effects of COVID-19 outbreak on the Nigerian Stock Exchange performance: Evidence from GARCH Models. *Journal Stat. Model. Anal.* 4, 25-38.

Adenomon, M.O and Idowu, R.A (2023). Modelling the Impact of the Covid-19 Pandemic on Some Nigerian Sectorial Stocks: Evidence from GARCH Models with Structural Breaks. *FinTech* 2, 1-20. https://doi.org/10.3390/fintech2010001.

Dickey, D. A. and Fuller, W. A. (1981) Likelihood ratio statistics for autoregressive time series with a unit root, Econometrica, 49(4), 1057-1072.

Farabiyi, A. and Asongu, S. (2020). The economic consequences of the COVID-19 pandemic in Nigeria. No 20/042, Working Papers of the African Governance and Development Institute. from African Governance and Development Institute.

Inegbedion, H. (2021). Impact of COVID-19 on economic growth in Nigeria: opinions and attitudes. *Heliyon*, 7(5).

Otache I. (2020). The Effects of the Covid-19 Pandemic on Nigeria's Economy and Possible Coping Strategies. *Asian Journal of Social Sciences and Management Studies*, 7(3): 173-179.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289-326.

Phillips, P. C. B. (1987) Time series regression with a unit root, Econometrica, 55, 277-301.

Phillips, P. C. B. and Perron, P. (1988) Testing for a unit root in time series regression, Biometrika, 75, 335-346.

Sansa, N.A(2020). The Impact of the COVID-19 on Financial Markets Evidence from China and USA. Election. *Res. J.Soc. Sci. Humanit.* 2, 29-39.

WHO. (2020). The classical definition of a pandemic is not elusive. Bull World Health Organ, 89(7), 540-541. doi: 10.2471/blt.11.088815