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EXCHANGE RATE, STOCK MARKET PERFORMANCE AND THE COVID-19 PANDEMIC IN NIGERIA

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Abstract
This paper evaluates the interaction among exchange rate, stock market performance and the COVID-19 pandemic in Nigeria for the period spanning February-September, 2020 using daily exchange rates, stock market index, a measure of stock market performance, and COVID-19 related variables-confirmed cases, discharge rate and total death cases. The theoretical framework is rooted from the random walk theory modified to incorporate the portfolio adjustment approach to describe the relationship among the variables. Results from the Autoregressive distributed lag model (ARDL) demonstrate a long run relationship among exchange rate, stock market index and COVID-19 related variables. In the long run, first-period lagged estimate of number of death cases essentially causes exchange rate depreciation and in the short run, both first and second period lags of total death cases cause depreciation of the naira. In the long run, stock market index decline results in exchange rate depreciation while reduction in the second-period lag stock index results in depreciation in the short run. About 7% disequilibrium error is corrected per month assuming there exists a distortion from long run equilibrium. A more open economy is needed amidst containment measures of COVID-19 complemented by policy which enhances improvement in welfare including adequate investment financing, low utility charges among others.
Keywords: Covid-19, exchange rate, pandemic, stock market

Introduction

The outbreak of the novel corona virus in Wuhan late December, 2020 turned a global pandemic when it became apparently uncontrollable. Part of the aftermath effects of the global spread was observed from the frequent reduction of equities accompanied by huge stock market instability. Thus, the effect of the pandemic which subsequently resulted in homogeneous policy guidelines including lockdowns, social distancing measures, use of preventive tools among others, is quite observable in the financial and foreign exchange markets thereby causing further anxiety and stresses. Between February 29 and March 9, 2020, the Nigeria's first index case was maintained and accompanied stock indices of maximum and minimum values of 26426 and 25648 respectively. For the same period, the average exchange rate against the US dollar reached 306.5. The intensity of the negative effect became pronounced as the spread rate increased leading further to the decline in the growth of stock index together with exchange rate instability. These and other economic instabilities resulted in the first lock down on March 30, 2020. By April 1, 2020 when the confirmed cases reached 174, the stock index already dropped to 21101 with exchange rate depreciation reaching 360.5 N/$. However, thereafter the stock index began to gain a relative increasing trend; this may be explained by the ease of the lock down rules which permitted some relaxing

business transactions even though not at full capacity with the official exchange rate on the same depreciation pace of 360.5N/$. Between May and September, 2020 even with increasing number of confirmed cases, the stock index truncated but still higher in most cases than what was recorded in April, 2020. This is still in line with the reduction in spread rate compared to the previous months. Again, relative compliance to preventive measures-social distancing, use of face masks and other measures were seen to be adhered to. By September 1, 2020, the stock index was already 25414 with 379.5N/$. The stock index appeared high but the growth rate was just 0.34% compared to about 0.78%, 0.45% and 16.46% around early August. The fact of the case is the trending economic significance of the pandemic on the foreign exchange market and financial market. The frequent uncertainties and in compliance with official directives to mitigate the negative effect of the virus halted business and financial market participants and thus causing downward trend in economic and financial indices. The fear of limiting investments due to uncertainty resulted in supply chain disruption, thus, affecting both local and foreign consumers (Osagie et al, 2020). According to Igwe (2020), the worst-ever economic recession has hit deep into the world economy based on the pandemic effects. Accordingly, shocks arising from such pandemic increases volatility and can create a negative effect on the economic and financial system of affected economy. Over the period, economic uncertainties have almost crippled the economy to a large extent. Demand and supply trend are at variance and various prices escalated. The need to urgently mitigate the effect of the pandemic from exposing the economy into further economic and financial crisis is a strong motivation for the study. Subsequently, this paper examines the relationship between COVID-19 and stock market performance and subsequently the role the affected stock market plays in exchange rate movement. Session 2 discusses related literature while session 3 explains the theory and methodology. Session 4 is the analysis and discussion while session 5 concludes.

Literature Review

Traditionally some important theories are depicted to explain stock movements. These include but not limited to Efficient Market Hypothesis (EMH), Random Walk Theories (RWT), Modern Portfolio Theory (MPT), Diversification, Behavioural Finance and the Hedging theory. This study is only limited to the EMH and RWT for modification to incorporate COVID-19 pandemic effects.

EMH states that the stock already reflects all available information (Hull, 2012, p.358). Given that the hypothesis prevails, then the stock market price in time t reflects what is expected of the worth of the security at time $t+1$(Brown (2011, p.82). And accordingly, the EMH does not seem to specify the mechanisms through which the prices reflect the available information with no specification of the rationality of market price. However, the possibility of bubbles may make EMH silent (see Bodie et al., 2011, p.373). Random work theory goes at variance with the EMH as it is of the notion that if he stock price is responsive to any available information as in the case of exchange rate fluctuations and the COVID-19 pandemic, it must increase or decrease accordingly with the available information. Hence, the unpredictability of information makes the stock price be unpredictable as well. This thus subsequently leads to the theory of random walk stating that price movement must be random and remains unpredictable (Hull, 2012, p.358). Within the shortest possible time, the corona virus pandemic has gained a lot of attention within the local and global economies particularly as it affects

the health, economic and financial indices. In line with this, a few studies explore into the negative impact of emergencies on stock market performance. Goh and Law (2002) observed that the 1997 Asian financial crisis and the 1998 Hong Kong avian outbreak of influenza resulted in an indirect significant relationship with tourism. The study by Mctier, Tse, and Wald (2011) demonstrated the effect of flu on the US stock market and found that increasing trend in the flu resulted in a downward trend in the zeal to trade in the stock market and hence reduced returns. Similarly, Chen, Jang, and Kim (2007) showed that SARS caused a decline in stock prices in the hotel industry just as it has a significant effect in the financial integration of the stock market in China and Asia (Chen, Jang, and Kim (2007). Effect of COVID-19 has been felt in terms of sustaining huge negative effects on the global economy (Iyke 2020a). Narayan and Phan (2020) evaluated impact of COVID-19 on the stock market and countries corresponding responses. Stock markets have been seen to be interlinked and interdependent especially on the cross-market correlation during crises. Chiang, Nam, and Li (2007) studied the daily stock returns for nine Asian markets during 1996-2003 and observed high correlation among Asian countries during the period. The global stock markets are becoming more interdependent and as such, such crises in one country tend to spread to another Morales and Callaghan (2012). In the study of the impact of COVID-19 on the global economy, Ozili and Arun (2020) concluded that the pandemic has had an enormous negative impact on the Nigeria's stock market due to business and financial markets closure. The exponential spread of the virus can results in loss of consumers' confidence and lower the zeal of investors and trading partners. The study of Chukwuka and Ekeruche (2020) on the impact of the pandemic on the Nigerian economy showed the truncation of the estimated 2.5% Nigeria GDP growth in 2020 leading to huge debt services and revenue ratio of 60% amidst falling oil prices.

Theory and the Methodology

Theoretical model relies upon the random walk theory as discussed above but modified putting into consideration effect COVID-19 has on stock market and then on exchange rate movements. On the basis of the random walk theory, the unpredictability of information invariably makes stock market information and likewise exchange rate movement becomes also unpredictable. The period of COVID-19 accompanies varying information relating to infections in terms of confirmed cases, death cases, discharge cases etc. Such information is highly unpredictable until current information is obtained. This unpredictability significantly affects the stock market output and subsequently exchange rate movements. This is also in line with the fact that price movement must be random and unpredictable (Hull, 2012, p.358). In this case, stock market index and exchange rate must be unpredictable given the unpredictable information from the COVID-19 pandemic. Given the knowledge about the price movement due to historical information, it seems difficult to make extra ordinary profits since there exists the knowledge about the direction of price movement (Hillier et al., 2010, p. 353 and Bodie et al., 2011, p.275). This is the weak form of EMH. This study therefore attempts to fit-in the portfolio-adjustment approach, which essentially describes stock market prices as major causes of exchange rate changes, into the random walk theory to be able to explain the interaction between stock market performance and exchange rate amidst COVID-19 pandemic.

The estimation method for this study considering the focus relies on the Autoregressive distributed lag model (ARDL) with the justification that this method is insensitive to the order of integration of the variables under consideration and is

accompanies with it a robust and reliable results irrespective of the sample size. It equally generates both the short and long run results simultaneously Pesaran H, Smith R, Shin Y (2001). Before the estimation, the study embarks on exploration of the statistical properties of the variables through the Philips Peron (PP) unit root test method. This is justified on the basis that it does not require selecting the level of serial correlation although it is based on asymptotic theory and as well as shares some of the disadvantages of the Augmented Dickey Fuller (ADF) test.

It would be recalled that the Dickey Fuller (DF) test fits the regression line

$$\Delta y_t = \theta_1 y_{t-1} + \theta_0 + \varepsilon_1 \quad (1)$$

Using the ordinary least square but this accompanies with it the serial- autocorrelation problem. The ADF corrects for this by introducing the lag of first differences of y_t. Hence, the PP fits equation (1) with the results used to compute the test statistic. Therefore on this basis of this, equation (2) is estimated

$$y_t = \gamma_1 y_{t-1} + \gamma_0 + \varepsilon_2 \quad (2)$$

But ε_t in equation (1) is integrated at its level but may be heteroscedastic so that the PP test corrects for both the serial correlation and heteroscedasticity in the error terms non-parametrically by a simple modification of ADF test. The PP test is viewed as ADF made to be robust to serial correlation using the Newest –West (1987) heteroskedasticity- and autocorrelation-consistent covariance matrix estimator.

In summary, the PP test involves fitting the regression line:

$$y_i = \rho_0 + \rho_1 y_{i-1} + \varepsilon_t \quad (3)$$

With respective statistics

$$z_\rho = n(\hat{\rho}_n - 1) - 0.5n^2 \frac{\hat{\sigma}^2}{s^2_n}(\hat{\delta}^2_n - \hat{\Omega}_0, n) \quad (4)$$

$$z_T = \sqrt{\frac{\hat{\Omega}_0, n\hat{\rho}_n - 1}{\hat{\delta}^2_n \hat{\sigma}}} - 0.5(\hat{\delta}^2_n - \hat{\Omega}_0, n)\frac{1n\hat{\sigma}}{\hat{\delta}_n s_n} \quad (5)$$

With the definitions:

$$\hat{\Omega}_{j,n} = \frac{1}{n}\sum_{i=j+1}\sum_i \hat{\sum}_{i-j} \quad (6)$$

$$\hat{\delta}_n = \hat{\Omega}_{n,n+2}\sum_{nj=1}^{q}(1 - \frac{j}{q+1})\hat{\Omega}_{j,n} \quad (7)$$

$$s^2 = \frac{1}{n-k}\sum_{i=1}^{n}\hat{\varepsilon}_i^{\,2} \quad (8)$$

ε_t is the OLS residual term, k is the number of covariates in the regression, q is the number of Newey-West lags for the calculation of δ^2_n and $\hat{\sigma}$ is the OLS standard error of $\hat{\rho}$

The ARDL model specification is:

$$\Delta lsmi = \alpha_0 + \sum_{i=1}^{m} \alpha_1 \Delta lsmi_{t-i} + \sum_{i=1}^{m} \alpha_2 \Delta lcc_{t-i} + \sum_{i=1}^{m} \alpha_3 \Delta tdc_{t-1} + \sum_{i=1}^{m} \Delta dc_{t-i}$$
$$+ \beta_1 lsmi_{t-1} + \beta_2 lcc_{t-1}$$
$$+ \beta_3 ltdc_{t-i} + \beta_4 ldc_{t-i} + \varepsilon_t \quad (9)$$

$$\Delta lexr = \sigma_0 + \sigma_1 \sum_{i=1}^{m} \Delta lexr_{t-i} + \sigma_2 \sum_{i=1}^{m} \Delta smi_{t-i} + \gamma_1 lexr_{t-1} + \gamma_2 smi_{t-1} + \varepsilon_t$$

(10)

With error correction specifications:

$$\Delta lsmi = \alpha_0 + \sum_{i=1}^{m} \alpha_1 \Delta lsmi_{t-i} + \sum_{i=1}^{m} \alpha_2 \Delta lcc_{t-i} + \sum_{i=1}^{m} \alpha_3 \Delta ltdc_{t-i} + \sum_{i=1}^{m} \Delta ldc_{t-i} + ecm_{t-i} + \varepsilon_t$$

(11)

$$\Delta lexr = \sigma_0 + \sigma_1 \sum_{i=1}^{m} \Delta lexr_{t-i} + \sigma_2 \sum_{i=1}^{m} \Delta lsmi + ecm_{t-i} + \varepsilon_t$$

(12)

Where $lsmi$ is the log of the stock market index representing the stock market performance, lcc is log of confirmed cases of COVID-19, $ltdc$ is log of total death cases, ldc represents discharge cases and ecm indicates the error correction term. α_0 $,.....,\sigma_2$ are the parameters, $t-i$ is the lag order while ε_t denotes the error terms. Daily data on Exchange rate was collected from the Central Bank of Nigeria Statistical Bulletin; COVID-19 related variables were obtained from the World Health Organisation COVID-19 Global Health Data while the Stock index data came from the Nigeria Stock exchange. The period spanned February 29 –September 1, 2020. Stock index data was only available up to September 1as at the period of gathering the data.

Estimation and Discussion

Variable	*Mean*	*Median*	*stdev*	*skew*	*kurt*	$J-Bpr$	*Observations*
lcc	7.98	9.27	3.16	-1.15	3.13	0.00	185
ldc	6.82	8.05	3.49	-0.85	2.42	0.00	185
lexc	4.61	5.72	2.46	-0.85	2.19	0.00	184
ltdc	5.88	5.89	0.06	-1.91	5.77	0.00	123
lsmi	10.10	10.11	0.18	11.28	145.55	0.00	187

Table 1: Descriptive statistics

Table 1 discusses some statistical properties of the variables employed. The stock index comes with the highest mean and median. This may be linked to the growth in stock index values recorded over time though at a declining rate. The standard deviation is

highest for the number of discharge cases and lowest for total death cases resulting from COVID-19. This is not surprising because the number of death due to the pandemic is comparatively lower than the number of infected. All the variables' tails are skewed to the left except the stock index while none of them has a negative kurtosis.

Variable	*Test Eqn.*	*Test Method*	*Adj. t – stat*	*Critical values*	*Decision*	*OI*
lcc	$\alpha, trend$	*PP*	-6.35	-3.44	*Stationary*	$I(1)$
ldc	$\alpha, trend$	*PP*	-20.86	-3.44	*Stationary*	$I(1)$
lexc	*None*	*PP*	-2.47	-1.95	*Stationary*	$I(1)$
ltdc	$\alpha, trend$	*PP*	-13.11	-3.44	*Stationary*	$I(1)$
lsmi	*None*	*PP*	-135.79	-1.94	*Stationary*	$I(1)$

Table 2: Unit root test

The PP test for stationarity is as shown in table 2 where all the variables-confirmed cases, discharge cases, total death cases, stock index and stock market index are stationary in their first differences. For ARDL to be suitable as a methodology, the series should be I (1) or I (0), a condition which has already been met as seen above.

Test statistics		
F-statistics	6.11	
Critical value bounds		
Significance levels	I(0)	I(1)
10%	2.20	3.09
5%	2.56	3.49
1%	3.29	4.37

Table 3: ARDL Bound test

The bound test for cointegration in table 3 demonstrates the existence of long run relationship among exchange rate, stock index, confirmed cases, discharge cases and total death cases as the F statistics exceeds the critical values at the 5% level. By

implication aftermath effect of COVID-19 on stock market index may be prolonged as long as the former still persists and this invariably alters exchange rate movements. The ARDL long and short run coefficients are therefore presented as follows:

Variable / Dep. Var: lex	Coefficient	Standard error	t-statistics	P-value
Long run elasticities				
lexc(-1)	-0.07	0.06	-1.09	0.28
lcc(-1)	-0.01	0.01	-1.58	0.12
dc(-1)	0.01	0.003	2.02	0.05*
tdc(−1)	0.01	0.01	0.85	0.40
lsmi(-1)	-0.02	0.03	-0.50	0.62
c	0.58	0.49	1.17	0.24
Short run elasticities				
Δ*l*cc	-0.05	0.01	-5.39	0.00**
Δ*l*cc(-1)	0.13	0.01	11.56	0.00**
Δ*l*cc(-2)	0.08	0.02	3.96	0.00**
Δ*l*dc	-0.02	0.01	-1.90	0.06*
Δ*l*dc(-1)	-0.02	0.01	-2.16	0.03**
Δ*l*dc(-2)	0.05	0.01	4.37	0.00**
Δ*l*tdc(-1)	0.01	0.02	0.44	0.66
Δ*ltdc*(−2)	0.05	0.01	-3.86	0.00**
Δ*l*sid	-0.0003	0.003	-0.10	0.92
Δ*l*sid(-1)	0.02	0.01	2.78	0.01**
Δ*l*sid(-2)	-0.01	0.05	-0.14	0.89
ecm(−1)	-0.07	0.02	-4.21	0.00**

$\hat{R}^2$	0.83			
R^2	0.81			
$D-W$ *statistics*	29.45/0.03			
Serial Correlation χ_{sc}	1.22/0.54			
Heteroscedasticity:χ_{het}	50.27/0.00			

Table 4: *Short run and long run elasticities*

Table 4 describes the long run and short run elasticities from the ARDL model. Starting from the long run equation, the initial exchange rate movement negatively impacts on the current exchange rate; thus a 10% decrease in the initial exchange rate is associated with about 0.7% rise in current exchange rate. Initial appreciation in local currency appears unsustainable on the current value of local currency amidst COVID-19 pandemic. Initial number of confirmed cases negatively impacts on current exchange rate. This may particularly be true in the cases of asymptomatic conditions. A 10% increase in the discharge cases results in about 0.1% increase in exchange rate showing that the number of discharge cases contributes though marginally to currency depreciation. Total death cases from COVID-19 relate positively with the current exchange rate meaning that the pandemic negative effect causes obvious exchange rate instability. Stock index shows a significant inverse relationship with exchange rate as a 10% decline in stock index results in about 0.2% increase in exchange rate. Low level of stock index amidst COVID-19 remains a key stimulant for exchange rate depreciation.

In the short run, only the one-period and two-period lagged estimates of confirmed cases are positively and significantly related to current exchange rate. The current and one-period lagged estimates of discharge cases relate negatively and significantly with exchange rate. By implication, in the short run, increasing number of discharge cases seem to cause some appreciation in exchange rate through boosting economic activities. One and two period lagged estimates of total death cases show insignificant positive relationship with exchange rate as a 1% increase in death due to COVID-19 results in about 0.1% and 0.5% increases in exchange rate respectively. For same short run period, current stock market index and its second period lag have positive and negative impacts on exchange rate. In all estimated models, exchange rate response to all explanatory variables within the long run and the short run remains inelastic Furthermore; the study carries out stability test to ascertain the degree of stability of the model using cumulative sum of recursive residual (CUSUM) and cumulative sum of squares of recursive residual (CUSUMQ). The CUSUM test indicates that recursive error marginally cuts the critical line and thus, the system is unstable while for the CUSUMQ test, the recursive error falls within the critical line making the system stable

Main Conclusion

This paper evaluated the relationship among COVID-19 pandemic, stock market performance and exchange rate from February to September of 2020 being the period

characterized by the pandemic crisis. Exchange rate instability appeared highly conspicuous amidst declining stock market performance. This is in connection with the containment measures put in place which retarded economic and financial activities and resulted in stock market poor performance during the period. The ARDL employed showed that both in the long run, increase in the first period lag of total death cases arising from COVID-19 resulted in depreciation of the naira while in the short run, its first and second period lags resulted in depreciation as well. The first-period lagged stock market index reduction led to depreciation of the naira in the short run while the second-period lagged stock index led to depreciation in the short run. Containment measures already put in place are welcoming and Nigerians are strongly advised to follow suit. Presently, the economy still suffers from the ongoing COVID-19 crisis as business and productive activities are yet to regain normal position. This has subsequently led to Nigeria recording negative growth rates in two consecutive quarters. Nigerians need support through making available investment funds and regulating any policy that can worsen the welfare of the masses at the current period. While the economy should still be more open, strict adherence to the COVID-19 rule should be maintained in all honestly. In the process of maintaining COVID-19 rule, attention should be more on improving the local production amidst adequate financing.

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