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Exchange rate innovation, global pandemic and stock market returns: Empirical evidence from ECOWAS countries

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Abstract

This study used the panel VAR impulse response function model and high-frequency monthly data from 2020M1 to 2021M12 to examine the response of innovations in the exchange rate and stock market returns to the COVID-19 pandemic in Economic Communities of West African States (ECOWAS). The study found that the effect of shocks of COVID-19 today on future exchange rate innovation worsens the real conditions of exchange rate innovation in ECOWAS countries. Again, the impact of the shocks of COVID-19 today on future stock market returns encourages the real conditions of stock market returns in ECOWAS countries. It was recommended that instead of lockdown, ECOWAS governments should explore other policy options peculiar to the region in COVID-19 containment and also strive harder to deepen the stock market and encourage increased utilization of information and communication technology in stock market trading to cut costs, raise returns and connect trade with the rest of the world's stock markets.

Keywords: ECOWAS, Exchange rate innovation, Global pandemic, Impulse response function, Panel VAR, Stock market returns.
JEL Classification: E44; G0; C23; C3.

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Contents

Contribution of this paper to the literature
This study is original in its use of a Panel VAR impulse response function model with high-frequency monthly data from 2020M1 to 2021M12 specifically examining the differential impacts of COVID-19 on exchange rate innovations and stock market returns in ECOWAS countries highlighting the unique regional responses.

1. Introduction

The recent global pandemic of COVID-19 and its variants has become a worldwide risk as exemplified by the nature of its impact. The unexpected worldwide event has tested the sustainability and strength of almost every economic and social framework (Singh & Shaik, 2021). On March 11, 2020, the World Health Organization (WHO) labeled it a global pandemic due to the speed and rate of its global spread. Governments from worldwide have worked together since the WHO proclamation to put policies in place to stop its spread. Regular hand washing with soap and hand sanitizer, wearing a nose mask in public, forbidding all social, political and religious gatherings, restricting movement within states and regions, banning international travel, physical and social seclusion and total economic lockdown are all included in the measures (World Health Organisation, 2020).

The economic effects of some of these policy initiatives have started to unravel in many economies especially African economies even though they may sound nice and have a clear goal to reduce health risks (Ifelunini, Ugwu, Ichoku, Omeje, & Ihim, 2018; Raifu, Kumeka, & Aminu, 2021) African economies have been ravaged by the recent global pandemic. The multifaceted crisis affected the economy and the health system and grossly impacted both the demand and supply sides. The supply chain and demand experienced reductions since people work mostly from home and consume less while firms diminished their productivity and investment (Loayza & Pennings, 2020). Thus, the pandemic has devastated effects in all sectors, especially the commodity, stock and foreign exchange markets (Chowdhury, 2022; Manasseh & Omeje, 2016). According to the World Bank report, crude oil prices crashed by 50% in the first quarter of 2020 (World Bank, 2020). This was the result of excess supply, low demand, and a lack of storage space (Wilson, 2020). This affected the foreign exchange earnings of African countries that rely heavily on oil exportation. The COVID-19's adverse impact on crude oil prices was transient (Singh & Shaik, 2021). The impact on stock markets was more evident particularly during the first wave (Mzoughi, Urom, Uddin, & Guesmi, 2020).

During the first wave, stock markets fell all around the world, including in Africa as a result of largely adverse reports continuing to flow in western countries on the spread of COVID-19 (Conlon & McGee, 2020; Sharif, Aloui, & Yarovaya, 2020; Zhang, Hu, & Ji, 2020). The World Economic Forum believed that the financial sector will have lost a total of around 9 trillion US dollars between the first and second quarters of 2020 (World Economic Forum, 2020). According to the International Monetary Fund (IMF), the recent global pandemic generated a severe economic crisis different from the others (Georgieva, 2020).

Prospects for most countries in West Africa were bad after the hit of the first wave of COVID-19 particularly when crude oil and other commodity prices crashed in the first quarter of 2020. Several countries in West Africa managed to keep growth positive in 2020 including Ghana with 1.7% growth (after 6.5% in 2019) while Côte d'Ivoire maintained a 1.8% growth rate (compared to 6.4% in 2019). However, Nigeria which heavily relies on oil saw its economy contract by 3%. The Nigerian stock market also suffered ending the first quarter of 2020 with a 3.72% decrease resulting in a loss of nearly $2 billion (Zoungrana, Toe, & Toé, 2021). Additionally, the currencies of most West African countries depreciated during the pandemic exposing local firms to exchange rate risks (Omeje, Ifelunini, Mba, & Okereke, 2022; Zerihun, 2021). Exchange rate risk has an impact on a firm's value (Dominguez & Tesar, 2006) which forces firms to devote significant resources to managing the risk (Jorion, 1991). Studies have sought to look into how COVID-19 has affected financial markets with the rapid spread of the recent global pandemic. This study is of the view that the global pandemic disrupted among others, foreign exchange markets (Iyke, 2020a; Narayan, 2020) and insurance markets (Wang, Zhang, Zhang, Gao, & Lin, 2021), oil markets (Devpura & Narayan, 2020; Iyke, 2020b; Prabheesh, Garg, & Padhan, 2020) and stock markets (Mazur, Dang, & Vo, 2020; Narayan, Sharma, Phan, & Liu, 2020; Topcu & Gulal, 2020). However, studies that have linked innovation in exchange rate to stock market returns during the present worldwide pandemic were not carried out in ECOWAS countries as a whole. In this sense, the current objective is to *examine the response of innovations in exchange rate and stock market returns to the COVID-19 pandemic in ECOWAS countries.*

The rest of this paper is structured as follows: Literature review, methodology, data analysis and conclusion and policy recommendation.

2. Literature Review

In terms of the theoretical underpinning of this study, relevant theoretical literature was examined. For instance, the safe-haven theory suggests that during times of uncertainty, investors flock to safe assets, like gold or currencies of countries with stable economies (Conlon & McGee, 2020; Latif et al., 2021). This can lead to a stronger currency for those countries and a weaker currency for countries that are seen as being more risky (Conlon & McGee, 2020). This theory is very relevant to this study because during the COVID-19 pandemic, the stipulation of this theory was experienced as investors moved their money to safe assets like the US dollar and the Swiss franc. Again, the relationship between the stock market returns and foreign exchange rate was theoretically supported (Agyei et al., 2022).

Another relevant theory is the flow-oriented theory of Dornbusch and Fischer (1980) which focused on the link that exists between exchange rates and some variables that are capable of making any economy volatile which in the case of this study include global pandemic and stock market returns. According to this theory, the demand and supply of currencies in the foreign exchange market predominantly influence the rates of exchange which in turn are influenced by the goods, services and financial capital flow of different economies (Dornbusch & Fischer, 1980). Dornbusch and Fischer (1980) argued that changes in relative prices and interest rates affect the demand for and supply of currencies. For example, when there is a relative rise in domestic interest rate with respect to foreign interest rates, foreign investors would be enticed, hence creating a rise in domestic currency demand. Similarly, changes in expectations about future exchange rates or economic conditions can influence the supply and demand for currencies (Iyke & Ho, 2021). The flow-oriented theory emphasizes the importance of expectations and adjusts

in the short-run to maintain equilibrium in the foreign exchange market. It suggests that exchange rate changes can help restore balance between domestic and foreign goods markets facilitating the adjustment process in the economy (Tan et al., 2022).

On the other hand, the portfolio balance theory of Frankel (1984) focused on the relationship between exchange rates and portfolio investment flows. This theory suggests that exchange rates are influenced by the preferences of investors for different currencies as they allocate their portfolios (Frankel, 1984). Investors allocate their portfolios based on a combination of risk and return considerations. They choose currencies based on the expected returns and risk associated with holding assets denominated in those currencies. If the expected returns of a particular currency increase, investors will demand more of that currency leading to an appreciation in its exchange rate. The portfolio balance theory also emphasizes the role of capital mobility and the integration of financial markets (Khan & Abbas, 2015). It suggests that changes in portfolio investment flows can lead to shifts in exchange rates (Khan & Abbas, 2015).

The flow-oriented theory of Dornbusch and Fischer (1980) and the portfolio balance theory of Frankel (1984) highlight the importance of flows of goods, services and financial capital in determining exchange rates. The portfolio balance theory specifically considered the role of portfolio investment flows and investor preferences in exchange rate determination while the flow-oriented theory focused on broader macroeconomic factors.

Empirically, there is a dearth of literature that examines exchange rate innovation, global pandemic and stock market returns in ECOWAS countries. As a result, this study reviewed related empirical literature with respect to exchange rate, COVID-19 and stock market. For instance, Rai and Garg (2022) examined whether COVID-19 significantly influences the dynamic relationship of BRIICS (Brazil, Russia, India, Indonesia, China and South Africa) economies' stock market and exchange rate. The study used Vector Autoregressive (VAR) model and time series daily data spanning from 2020D1 to 2020D30 to discover that COVID-19significantly and inversely impacts the worldwide economy. The study also analyzed the dynamic connection between the exchange rate and stock market in each of the BRICS (Brazil, Russia, India, China, and South Africa) economies and found that pandemic had a significant influence on the varying relationship that exists among stock market and exchange rate in the BRIICS economies. This influence here raises the volatility of both the stock market and exchange rate in all of the BRIICS economies. However, it was recommended that there is a need to consider the influence of the COVID-19 pandemic on the monetary markets in these emerging economies. Similarly, Wong (2022) examined the connections between the rate of exchange and stock prices in several countries like Japan, the US and other European countries. An econometric model based on Ordinary Least Squares (OLS) was applied to the time series panel data generated for the study to test whether there exist causal connections among real stock prices and real rates of exchange. The finding of the study showed that rates of exchange significantly affect stock prices although the strength of the connections varies across countries. Again, the study found that when domestic currency is depreciated, it would lead to a rise in stock prices. However, when it is appreciated, it would result to a fall in stock prices. It was recommended that policymakers need to ensure stable rates of exchange. Similarly, Jamal and Bhat (2022) adopted panel data and the panel Autoregressive Distributed Lag (ARDL) model to assess the movement of exchange rates in the UK, China, Turkey, India, Italy, and Brazil. It was found that an increase in deaths as a result of COVID-19 depreciated exchange rates in the sampled economies.

In a different study that relates stock market and COVID-19, Sharif et al. (2020) studied the interrelationships between COVID-19, stock market, oil price volatility shock and the ambiguity of American economic strategy, and geopolitical risk. The study used time-series monthly data from 2020M1 to 2020M4 to investigate the influence of these factors on the US stock market. The study found that the pandemic and oil price volatility shock had a negative impact on the US stock market while geopolitical risk had a positive influence on the US stock market. The study recommended the need to consider the factors studied when making economic decisions by policymakers and investors.

Similarly, Hatmanu and Cautisanu (2021) examined how COVID-19 affected the Romanian stock market. Monthly time series data from 2020M1 to 2020M12 and descriptive statistics OLS based multiple regression were adopted for the study. It was found that COVID-19 had a negative and significant influence on the Romanian stock market with the key stock index undergoing a sharp fall in 2020M3 with a gradual recovery thereafter. It was recommended by the study that there is a need for policymakers and investors to consider the unique characteristics of the pandemic when making decisions about investments and economic policies. Raifu et al. (2021) investigated the influence of the COVID-19 and lockdown policies on the stock earnings of 201 enterprises registered on the stock market of Nigeria. The study employed collectively OLS and panel data analysis models. The study showed that COVID-19 negatively and significantly influence stock market of Nigeria with the market facing a significant decrease in returns during the COVID-19. The study also revealed that the lockdown policies carried out by the Nigerian government exert significant reverse influence on firm stock earnings especially those found around the sectors of consumer goods and finance. The study recommended that investors and policymakers need to gently consider the potential influence of related policies and pandemic on the stock market and private companies.

Latif et al. (2021) examined the relationship that exists between changes in stock returns and COVID-19 using time series monthly data from the stock markets of China, Japan and the United States from 2020M1 to 2020M12 and employed an econometric model based on OLS to analyze the data. It was revealed that COVID-19 inversely and significantly influenced changes in stock returns in all three countries. There was an observed increase in stock return volatility and a decline in market liquidity during COVID-19. Furthermore, this study also empirically showed that COVID-19 led to increased market uncertainty as reflected in the higher levels of market volatility. Therefore, this study suggested that there is a need for monitoring of market trends during periods of economic uncertainty by relevant stakeholders. Rehman, Kang, Ahmad, and Vo (2021) investigated how COVID-19 could influence the G7 member countries' stock market volatility, returns and trading volume using time series monthly data from 2019M1 to 2020M12 and Granger causality test and the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model. There exist negative significant effects of COVID-19 on the G7 member countries' stock market returns. The virus increased stock market volatility and reduced trading volume. The study suggested that the government should strive harder to contain this virus so as to ensure the stability of stock markets and the associated returns and trading volume rise.

Lahmiri and Bekiros (2021) assessed how COVID-19 affects the long memory of volatility and returns in crypto currency and stock markets through the application of time series monthly data from 2015M1 to 2020M11. In a bid to determine the Hurst exponent which is a measure of long-term dependence or long memory, for Bitcoin, Ethereum, the Standard and Poor's 500 (S&P 500), and the National Association of Securities Dealers Automated Quotations (NASDAQ) 100, the study applied the Detrended Fluctuation Analysis (DFA) and the fractional integration technique, to and found that the effect of the virus on long memory was more pronounced in crypto currency markets than in stock markets. This suggests that the crypto currency markets were more damaged by the pandemic than the stock markets due to their higher volatility and lower liquidity. However, government and relevant agencies should educate people on this impact since knowing the dynamics of long-term dependence in financial markets especially during periods of financial and economic stress is important for all and sundry.

Furthermore, Basuony, Bouaddi, Ali, and EmadEldeen (2022) tried to determine how global stock markets were being affected by COVID-19 through the adoption of time series monthly panel data from 2020M1 to 2020M6 generated from 13 countries of the world. The effect of COVID-19 on stock market returns was heterogeneous across countries with some countries being more affected than others. They attribute this heterogeneity to differences in the severity of the pandemic, the effectiveness of government policies and the structure of the economies. This study revealed that there exist significant and widespread effects of COVID-19 on global stock markets with significant negative impacts on returns in all 13 countries studied. It was recommended that the government through its relevant authorities should encourage people to know and understand the underlying forces changing global financial markets and the potential effect of external stocks on these markets to be safe.

In an entirely different but related study, Rakshit and Neog (2021) examined how COVID-19 affects stock market earnings and volatilities using time series data from the S&P 500 table and the NASDAQ Complex index from 2019M1 to 2021M12. COVID-19 has contributed significantly towards stock market volatility with higher levels of volatility persisting even after the initial stock in 2020M3. The study brought insights into the complex and dynamic relationship between the pandemic and stock market. It was suggested among others that there is a need for varying factors that aid in good understanding the effects of COVID-19 on the global economy to be put in place by the government.

There are also studies that looked at investments like the study by Agyei et al. (2022) who examined how the COVID-19 pandemic affected the costs of imported rice, maize, native rice and sorghum in sub-Saharan Africa. Time series monthly data from 2019M1 to 2020M12 and OLS based multiple regression models were employed by the study for results analysis. It was revealed by the study that COVID-19 exerted a significant negative influence on the costs of imported rice, maize, native rice and sorghum in the sub region. A supply chain of these foods was disrupted and their production, distribution and marketing were also halted due to restrictions on movement and trade, the closure of borders and the reduced capacity of transportation systems. The study highlighted the need for policymakers and stakeholders in the agricultural sector to take care of COVID-19 challenges and its attendant effects to ensure food security and stability in SSA. Similarly, Omeje et al. (2022) looked at how the informal sectors' socioeconomics were being affected by COVID-19 in Nigeria using survey data from 340 informal business, descriptive statistics and a logit model. It was shown by the study that informal businesses making up about 83% were badly affected by COVID-19. In terms of their socioeconomic characteristics, it was found that occupation, age, labour cost, sex, receiving palliative, transport cost and location were the main significant factor that COVID-19 impacted. It was recommended that government need to ensure the sustainability of informal businesses for a faster recovery of the economy.

Xiang, Ma, Yu, Wang, and Yin (2022) examined on a global scale how the dynamics of COVID-19 pandemic contagion are being spread using a mathematical model and the Susceptible-Exposed-Infectious-Recovered (SEIR) model. This study indicated that the pandemic spreads through contagion channels directly and indirectly through its findings. They noted that the direct contagion channel is more important during the outbreak's early stages while that of the indirect contagion channel is more significant at a later stage. It was recommended among others by the study that relevant stakeholders and the government need to provide to the people insights on how the virus is being contracted even before and at early stage to ensure effective interventions in controlling its spread across different regions and countries of the world. Omeje, Mba, and Anyanwu (2023) and Omeje et al. (2023) also applied VAR to study the COVID-19 pandemic, employment differential and health expenditure relationship and environmental pollution and climate change relationship with respect to sub-Saharan African countries. These studies could not empirically give evidence of how exchange rate innovation, global pandemic and stock market returns interconnect with each other in ECOWAS countries, hence the need for this study.

3. Methodology and Data

3.1. Methodology

In this study, we applied the Panel VAR technique in our estimation. The adopted econometric specification of the model assumes the reduced form given below:

$$M_{it} = \Pi(h)M_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

Where M_{it} is a vector of stationary variables, $\Pi(h)$ is a matrix polynomial in the lag operator defined as $\Pi(h) = \Pi_1 h^1 + \Pi_2 h^2 + \Pi_3 h^3 \ldots + \Pi_p h^p$, μ_i represents a vector of country-specific effects and ε_{it} is a vector of idiosyncratic errors. The model includes variables such as the number of COVID-19 cases, exchange rate, stock returns and interest rates. We compute the impulse response functions (IRF) and the variance decomposition (VDC) after estimating all of panel VAR parameters. The IRF illustrates how an endogenous variable reacts over time to a shock in a different system variable (Omeje, Mba, Obodoechi, Ukwueze, & Urama, 2023; Paul & Omeje, 2022). On the other hand, VDC quantifies the contributions of each shock source to the variance of each endogenous variable over a specific forecast horizon.

3.2. Data and Sources

The data was generated from the 2021 World Development Indicators of the World Bank and Worldometer's COVID-19 data, 2022. A panel of three ECOWAS member countries and high-frequency monthly data was used from 2020M1 – 2021M12 for each of the three ECOWAS countries. In terms of definitions and sources, several cases of COVID-19 were sourced from Worldometer's COVID-19, 2022 whereas exchange rate, stock returns,

interest rate and inflation rate were represented as xchrate, stockm~t, intrate, and infltn and were sourced from 2021 World Development Indicators of the World Bank.

4. Empirical Results and Discussion

4.1. Descriptive Statistics and Variables in the Panel VAR Model

Descriptive statistics were applied to the model variables to investigate the nature of the variables in the Panel VAR model and the features of the data. This study looks at how much variation there is in the model variables' mean, standard deviation and minimum and maximum values. As a result, Table 1 provides descriptive statistics for the panel VAR model variables.

Table 1. Descriptive statistics results of panel VAR model variables.

Variables	Mean	Std. dev.	Min.	Max.	Observations
Xchrate					
Overall	220.521	210.631	1.796	510.527	N = 72
Between		256.105	1.875	502.284	n = 3
Within		4.793	212.278	228.765	T = 24
COVID-19					
Overall	88717.33	84422.54	419	241513	N = 72
Between		81159.67	3122	164560	n = 3
Within		51711.26	11764.33	165670.3	T = 24
Stockm~t					
Overall	4.377	2.649	0.353	8.200	N = 72
Between		0.864	3.568	5.286	n = 3
Within		2.542	0.453	8.301	T = 24
Intrate					
Overall	10.409	3.931	5.14	15.376	N = 72
Between		4.741	5.218	14.509	n = 3
Within		0.506	9.542	11.276	T = 24
Infltn					
Overall	6.973	4.869	-1.107	12.095	N = 72
Between		5.702	0.659	11.746	n = 3
Within		1.316	5.207	8.739	T = 24

Table 1 shows that the mean, standard deviation and corresponding minimum and maximum values for each variable exhibit sufficient variation. The total number of observations for the study (N) is 72 from January 2020 (2020M1) to December 2021 (2021M12) for each of the three ECOWAS countries. The between-panel group (n) consists of three observations representing the number of ECOWAS member countries sampled due to the availability of stock return data. The within-group panel (T) has 24 observations corresponding to the time periods for each country from January 2020 to December 2021. The mean exchange rate (xchrate) is approximately 220.52%, the mean number of COVID-19 cases is about 88,717.33, stock market returns (stockm~t) amount to approximately USD 4.38 billion, the interest rate (intrate) is around 10.41%, and the inflation rate (infltn) is about 6.97%.

Similarly, this study also examined the panel unit root test of the model variables to ascertain the stationarity level of these model variables. Furthermore, the study utilized the Fisher-type panel unit-root test based on the Augmented Dickey-Fuller (ADF) test of unit root. As a result, Table 2 contains the study's results for the panel unit root test.

Table 2. Panel unit root test results of the model variables.

Variables	Inverse chi-squared P	Inverse normal Z	Inverse logit L*	Modified inv. chi-squared Pm	p-values	Variable integration orders
Xchrate	57.380	-6.594	-9.397	14.832	0.0000	I(1)
COVID19	57.380	-6.594	-9.397	14.832	0.0000	I(1)
Stockmret	57.380	-6.594	-9.397	14.832	0.0000	I(1)
Intrate	38.254	-5.384	-7.761	12.110	0.0000	I(1)
Infltn	57.380	-6.594	-9.397	14.832	0.0000	I(1)

Note: L* = Inverse logit.

Table 2 shows that all four tests of the panel unit root based on Fisher ADF vehemently rejected the null hypothesis that all panels have unit roots after the first difference. This suggests that for all the examined variables, the inverse logit L* test and the inverse normal Z test are in agreement. The modified inverse ¬¬χ2 Pm test and the inverse ¬χ2 P test both agree with each other. P-values of all the model variables tested (xchrate, COVID-19 stockmret, intrate, and infltn) revealed that they are all significant after the first difference and as a result, are integrated of order one (that is I (1)) at the 5% level of significance.

4.2. Results of the Panel VAR Model Presented

This subsection presents the results of the panel VAR model in an attempt to ascertain the response of innovations in exchange rates and returns of the stock market to the COVID-19 pandemic in ECOWAS countries. As a result, Table 3 presents the panel VAR model's summary results.

Table 3. Summary results of the panel VAR model.

Variables	Coef.	Std. err.	Z	P>|z|
Xchrate				
Xchrate				
L1.	0.966	0.283	3.41	0.001
COVID -19				
L1.	-5.567	1.898	-2.93	0.003
Stockmret				
L1.	-55.637	86.299	-0.64	0.519
Intrate				
L1.	-0.147	6.020	-0.02	0.981
COVID -19				
Xchrate				
L1.	-0.000	0.000	-0.57	0.570
COVID -19				
L1.	0.964	0.077	12.56	0.000
Stockmret				
L1.	1.304	0.307	4.24	0.000
Intrate				
L1.	-0.039	0.055	-0.71	0.477
Stockmret				
Xchrate				
L1.	0.000	0.000	1.43	0.152
COVID -19				
L1.	0.003	0.003	0.94	0.348
Stockmret				
L1.	1.022	0.021	48.69	0.000
Intrate				
L1.	0.005	0.004	1.05	0.291
Intrate				
Xchrate				
L1.	-0.000	0.000	-0.07	0.941
COVID -19				
L1.	-0.033	0.044	-0.77	0.443
Stockmret				
L1.	-0.418	0.336	-1.24	0.213
Intrate				
L1.	0.874	0.105	8.33	0.000

Interpreting the panel VAR model is always very difficult. Hence, this study employed the orthogonalized Panel Vector Autoregressive - impulse response function (PVAR – IRF) to examine the study objective (i.e., to ascertain the response of innovations in exchange rate and stock market returns to the COVID-19 pandemic in ECOWAS countries).

However, Table 2 suggests that in the exchange rate equation (xchrate), the COVID-19 pandemic has a negative and significant effect on the exchange rate (xchrate) in ECOWAS countries by about 5.566697%. But in the stock market return equation (stockmret), the COVID-19 pandemic has a positive but insignificant effect on the stock market return equation (stockmret) in ECOWAS countries by about 0.35324%. In the interest rate equation (intrate), the COVID-19 pandemic also exerts a negative but insignificant effect on the interest rate (intrate) in ECOWAS countries by about 3.39404%.

This study resorted to the panel VAR impulse response function (PVAR – IRF) to ascertain the response of innovations in exchange rate and stock market returns to the COVID-19 pandemic in ECOWAS countries. Hence, this is presented below.

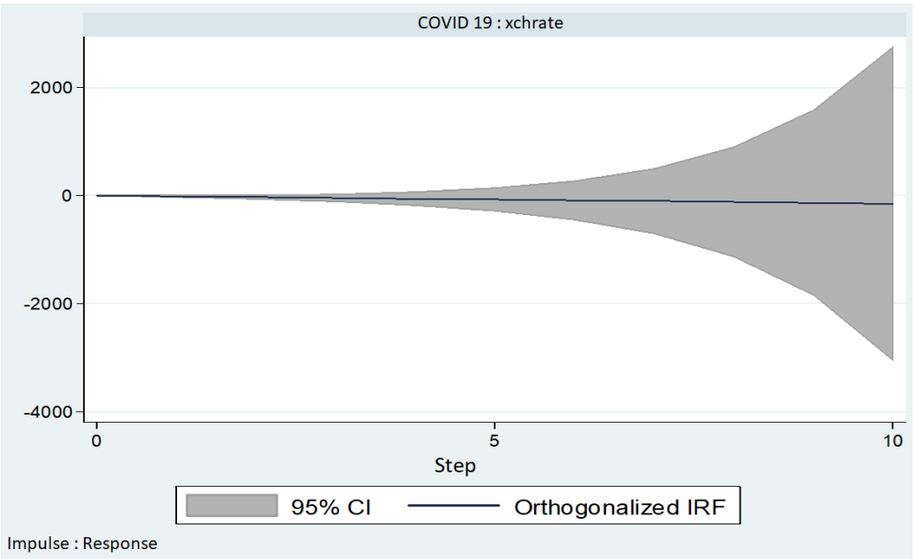

Figure 1. Orthogonalized impulse response function of exchange rate on COVID-19.

Figure 1 demonstrates how innovations in the exchange rate (xchrate) react to COVID -19 stimulus by gradually releasing significant and negative effects from the first period up to the tenth period without displaying

any indication of when it would eventually fade off in any of the periods. In other words, the empirical result suggests that a single standard innovation in COVID -19 causes negative effects on exchange rate innovation (xchrate). The results also demonstrate that these effects are within the 95% confidence interval. The implication here is that with innovation in COVID -19 by 1%, exchange rate innovation (xchrate) would also be significantly affected in the next period. The impact of shocks of COVID -19 today on future exchange rate innovation (xchrate) does not decay to 0 fast, rather, it worsens the real conditions of exchange rate innovation (xchrate) in ECOWAS countries. This implies that COVID -19 the effects of a shock on exchange rate innovation (xchrate) today does not show any sign of decay to 0 within the study period. This may be that all ECOWAS countries are mainly importers of all kinds of goods and services rather than exporters. They are primary or intermediate producers that sell their products at a cheaper rate and import the processed products at higher prices.

With respect to ascertaining the response of stock market returns (stockmret) to the COVID-19 pandemic in ECOWAS countries, the study presents Figure 2 given below.

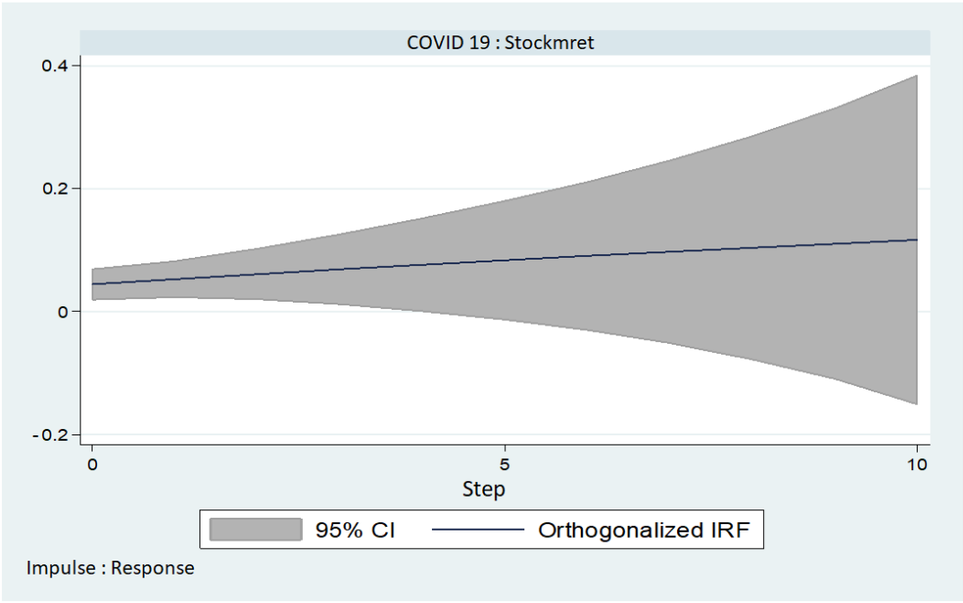

Figure 2. Orthogonalized impulse response function of stock market returns on COVID -19.

According to Figure 2, when COVID -19 generates an impulse, stock market returns (stockmret) react by emitting gradually considerable positive impacts from the first period up to the tenth period without exhibiting any indication of when it would eventually die off. The empirical results suggest that a one-standard deviation innovation in COVID-19 has a substantial positive impact on stock market returns (stockmret). Additionally, these effects fall within the 95% confidence interval. This indicates that a 1% innovation in COVID-19 would significantly influence stock market returns (stockmret) in the subsequent period. Furthermore, the impact of today's COVID-19 shocks on future stock market returns does not decay to zero quickly. Instead, it reinforces the real conditions of stock market returns in ECOWAS countries. This implies that the effects of a shock on stock market returns today do not diminish to zero within the study period over time. This empirical finding may result from the increased use of information and communication technology in stock market trading during the COVID-19 period.

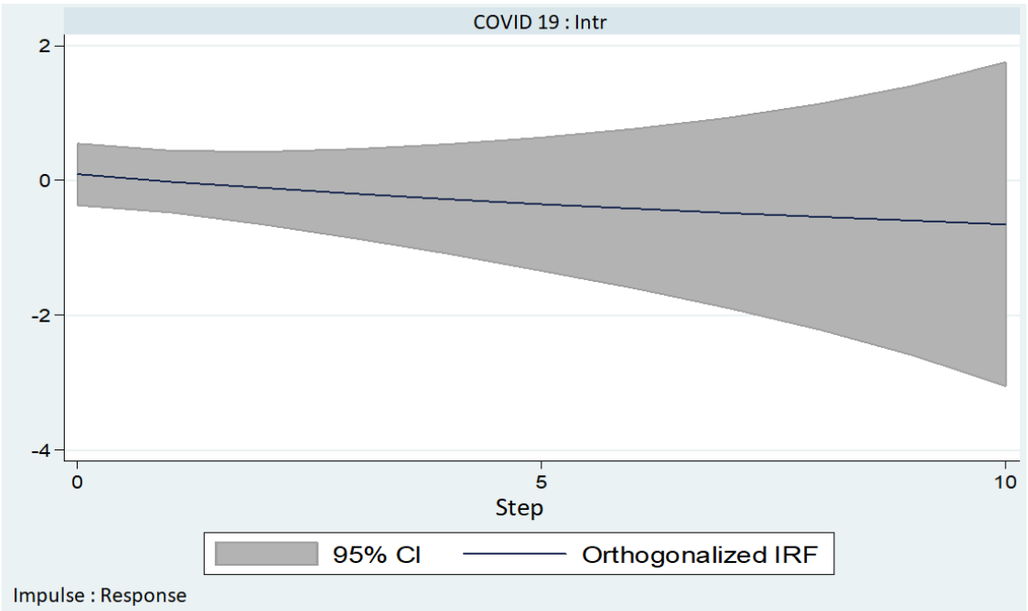

Figure 3. Orthogonalized impulse response function of interest rate on COVID-19.

For Figure 3, when over time provides an impulse, interest rate (intrate) reacts by gradually releasing significant negative effects from the first period up to the tenth period, when it ultimately goes away. According to the empirical findings, a one-standard deviation innovation in COVID-19 has a considerable negative impact on the

interest rate (intrate). The results also indicate that these impacts fall within the 95% confidence interval. This implies that a 1% innovation in COVID-19 would significantly affect the interest rate (intrate) in the subsequent period. Furthermore, the impact of today's COVID-19 shocks on future interest rates decays to zero quickly, worsening the real conditions of interest rates in ECOWAS countries. Thus, as time progresses, the effects of a shock to the interest rate today diminish rapidly within the study period.

Table 4. Summary results of the panel VAR stability test.

Eigenvalue		
Real	**Imaginary**	**Modulus**
0.962	0	0.962
0.962	0	0.962
0.962	0	0.962
0.208	0	0.208

Note: All the eigenvalues lie inside the unit circle.
PVAR satisfies the stability condition.

4.3. Panel VAR Stability Test

Table 4's PVAR stability test results show that all of the eigenvalues are less than one and hence lie inside the unit circle. As a result, the PVAR meets the stability requirement. The graph in Figure 4 clearly illustrates this scenario.

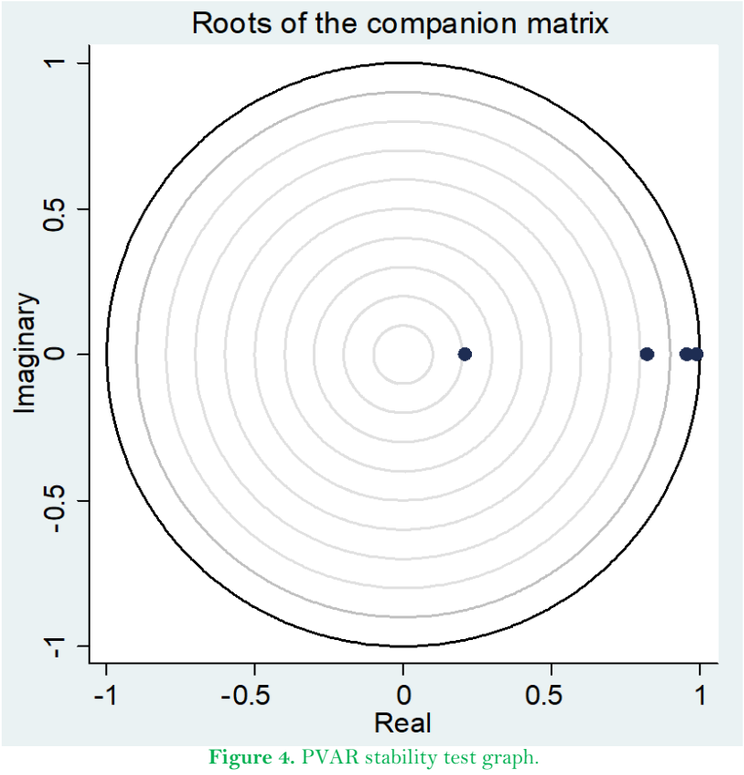

Figure 4. PVAR stability test graph.

All of the Eigenvalues' roots are shown to be inside the unit circle in Figure 4. The panel VAR process is said to be stationary. The PVAR model used to estimate model variables passed the Eigenvalue stability test as shown by the results of the PVAR stability test table and graph indicating that the PVAR satisfied the stability criteria.

Table 5. Summary results of the panel VAR forecast-error variance decomposition.

Response variable and forecast horizon	Impulse variable			
	Xchrate	**COVID-19**	**Stockmret**	**Intrate**
Xchrate				
0	0	0	0	0
1	1	0	0	0
2	0.999	0.000	0.000	3.580
3	0.998	0.001	0.000	1.310
4	0.995	0.003	0.001	3.340
5	0.993	0.005	0.002	7.390
6	0.988	0.008	0.004	0.000
7	0.982	0.011	0.007	0.000
8	0.975	0.015	0.009	0.000
9	0.966	0.020	0.014	0.000
10	0.954	0.026	0.019	0.000
Stockmret				
0	0	0	0	0
1	0.000	0.066	0.934	0.000
2	0.003	0.077	0.916	0.003
3	0.010	0.088	0.893	0.009
4	0.020	0.098	0.865	0.017
5	0.033	0.106	0.836	0.024
6	0.048	0.113	0.807	0.032

Response variable and forecast horizon	Impulse variable			
	Xchrate	COVID-19	Stockmret	Intrate
7	0.063	0.119	0.779	0.039
8	0.079	0.124	0.751	0.047
9	0.095	0.128	0.725	0.051
10	0.112	0.131	0.701	0.056

Table 5 reveals the impact of shocks to COVID-19 on the exchange rate (xchrate) and stock market returns (stockmret) in ECOWAS countries presenting the results of the panel forecast error variance decomposition. The findings indicate that a unit orthogonal shock in COVID-19 accounts for 0.000%, 0.000%, 0.001%, 0.003%, and 0.004% of the variance in the forecast error of innovations in the exchange rate (xchrate) during the first, second, third, fourth, and fifth timeframes, respectively. However, from the sixth to the tenth horizon, a unit orthogonal shock in COVID-19 is the sole contributor to the variance in the forecast error of innovations in the exchange rate (xchrate), accounting for 0.008%, 0.01%, 0.015%, 0.020%, and 0.026%.

The results indicate that a unit orthogonal shock in COVID-19 accounts for 0.000%, 0.065%, 0.078%, 0.088%, 0.098%, and 0.106% of the variance in the forecast error of stock market returns (stockmret) during the first through fifth horizons, respectively. In contrast, from the sixth to the tenth horizon, a unit orthogonal shock in COVID-19 is responsible for 0.113%, 0.119%, 0.123%, 0.127%, and 0.131% of the variance in the forecast error of stock market returns (stockmret).

5. Conclusion and Policy Recommendations

This study empirically analysed exchange rate innovation, global pandemic and stock market returns using evidence from ECOWAS countries. The study applied the Panel VAR impulse response function (IRF) model and high frequency data from World Development Indicators and Worldometer COVID-19 data sets from 2020M1 to 2021M12 to examine the response of innovations in the exchange rate and stock market returns to the COVID-19 pandemic in ECOWAS countries. The study's findings thus showed that when COVID-19 provides an impulse, innovations in the exchange rate (xchrate) react by emitting gradually significant negative effects up to the tenth period without exhibiting any indication that they will eventually die off in any of the periods. In other words, the empirical result suggests that a single standard innovation in COVID-19 causes negative effects on exchange rate innovation (xchrate). The results also demonstrate that these effects are within the 95% confidence interval. It follows that if innovation in COVID-19 increases by 1%, exchange rate innovation (xchrate) will likewise be significantly impacted in the next time frame. The impact of shocks of COVID-19 today on future exchange rate innovation (xchrate) does not decay to 0 fast; rather, it worsens the real conditions of exchange rate innovation (xchrate) in ECOWAS countries. This means that the effects of a shock on exchange rate innovation (xchrate) today do not show any sign of decay to 0 within the study period as time goes by.

The results regarding stock market returns (stockmret) indicate that when COVID-19 produces an impulse, stock market returns respond with gradually increasing significant positive effects that persist through the tenth period without showing any signs of diminishing. Consequently, the empirical findings reveal that a one-standard deviation innovation in COVID-19 has significant positive effects on stock market returns (stockmret) which fall within the 95% confidence interval. This implies that a 1% innovation in COVID-19 would also significantly affect stock market returns (stockmret) in the subsequent period. Furthermore, the impact of today's COVID-19 shocks on future stock market returns does not decay to zero quickly; rather, it reinforces the underlying conditions of stock market returns in ECOWAS countries. This suggests that the effects of a shock on stock market returns (stockmret) today do not show any sign of decay to 0 within the study period as time goes by. This finding may be as a result of the increased utilization of information and communication technology in stock market trading during the COVID-19 period.

Therefore, the study recommends from its empirical evidence that

1. ECOWAS country governments should try harder to look inward to explore each country's peculiarities that may aid in the containment of the spread of COVID-19, since the effects of shocks of COVID-19 today on future exchange rate innovation do not decay to zero fast; rather, it worsens the real conditions of exchange rate innovation in ECOWAS countries.
2. Governments of ECOWAS countries should urgently explore policy options beyond lockdown measures, as the study reveals that COVID-19 has a significantly negative impact on innovations in the exchange rate within the region. Imposing lockdowns in the face of poverty and hunger is not the best solution for the ECOWAS region, given that member countries primarily produce and export goods at low prices while importing them at higher rates.
3. Governments in ECOWAS countries should strive harder to deepen the stock market the more and encourage increased utilization of information and communication technology in stock market trading in a bid to cut costs, raise more returns, and connect trade with other stock markets in the rest of the world.
4. ECOWAS country governments need to encourage increase in investment by creating favourable investment climate that would encourage ease of doing business in the region.
5. Governments in the ECOWAS region and its monetary or regulatory authorities should also help in stabilizing and bringing down the lending interest rate for productive investments in the region since it was found that shocks of COVID-19 today on future interest rates worsen the real conditions of interest rate in ECOWAS countries.

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