An Empirical investigation of Remittance shocks on Economic Growth in Nigeria: Effect COVID-19 on Economic Growth for 2019-2020 Years

ABSTRACT

Aims: The study investigates the impact of remittances shocks on economic growth in Nigeria in the midst of Covid-19.

Study Design: This study is design to investigate the shocks effect of remittances on the economic growth in Nigeria in the midst of Covid-19. The analysis is based on monthly data, the period which study intends to cover is 24 months i.e. (2019m1-2020m12). Quantitative technique of data analysis is employed due to the nature of the study.The analysis is based on time series econometric modeling that establishes link between the variables of interest and controls for other variables affecting the relationship.

Place and duration of the study: Nigerian Economy in the midst of Covid-19 from 2019m1 to 2020m12.

Methodology: The study employed Structural Vector Autoregressive (SVAR) model.

Results: The results revealed that, the shock of remittances on real gross domestic product was found to be positive. Exchange rate has negative effect on real gross domestic product in Nigeria. Foreign direct investment has negative effect on real gross domestic product in Nigeria. The result from impulse response function shows that, the shock of remittances to real GDP in the midst of to Covid-19 pandemic has impacted positively. The Granger causality test shows that remittances granger cause real gross domestic product and real gross product granger cause remittances in Nigeria. Exchange rate granger cause real gross domestic product and real gross product granger cause exchange rate in Nigeria. Foreign direct investment granger cause real gross domestic product and real gross product granger cause foreign direct investment in Nigeria.

Conclusions: The study recommends that Nigerian government should provide means to make remittances cheaper as larger remittances inflows will make up for what may be lost as a result of COVID-19 pandemic and remittances should not be used for consumption purpose only rather for investment and consumption.

Keywords: Remittances, Exchange rate, Economic growth, Covid-19

JEL Classification: F24, O40, I15

1 INTRODUCTION

Remittances have become a vital source of development finance to developing countries (Jha, Sugiyarto & Vargas-Silva 2010), acting as compensatory transfers in bridging resource deficit gap for households, especially in low- and middle-income countries. It represents a major source of income for poor and vulnerable families in both developed and developing countries. According to the World Bank, remittances enable households with the ability to meet basic needs of life such as food, shelter and healthcare. This notion has gained empirical support as studies have also shown that remittances reduce poverty and inequality in low and middle-income countries (Akobeng 2015).

Remittances are transfers of money, goods and diverse traits by migrants or migrant groups back to their countries of origin. Although nowadays, the notion of remittances conjures only monetary aspect, remittances include both monetary and non-monetary flows, including social remittances (Alechenu, 2021). According to the IMF (1999), remittances consist of goods or financial instruments transferred by migrants living and working abroad to residents in the migrants' home economies. Calculations of remittances are limited to transfers made by workers that have stayed in foreign economies for at least one year and exclude transfers from migrants that are self-employed. In 2018, remittance flows to developing nations was estimated at $350 billion, this value is much higher than the total foreign direct investment, portfolio investment, as well foreign aid inflows. In 2019, Nigeria registered an inflow of US$25 billion remittance from Nigerians in the Diaspora. This amount constituted more than 80 per cent of the nation's annual budget and represents about 6 per cent of the Gross Domestic Product. In 2018, an estimated US$23.63 billion remittance inflow was received in Nigeria. This sum represents 6.1 per cent of Nigeria's GDP (Nevin & Omosomi, 2020).

Owing to the global economic crisis occasioned by the COVID-19 pandemic, a potential negative shock to remittances looks inevitable, with crucial implications for vulnerable households as well as developing countries for which remittances represents a significant share of gross domestic product (GDP). The World Bank (World Bank, 2020) has projected a decline in global remittances by 20% in 2020, said to be the largest decline in recent time, due to the economic crisis caused by the pandemic. In particular, low and middle-income countries are projected to experience a 19.7% decline (from $48 billion in 2019 to $37 billion in 2020) in remittances, 23.1% in sub-Saharan Africa, owing to fall in wages and employment of workers in host countries, with some of the top-remittance source markets for the region being in Europe, Middle East, China and US, which were among the places badly hit by the pandemic. The world economy experiences an unprecedented severe downturn in cross-border exchanges and remittances (World Bank, 2020), consequent upon the COVID-19-induced negative supply and demand shocks, with international trade and investment flows anticipated to drop by 30% and 40%, respectively; and rising unemployment rates in many countries (Solis, 2020).

The immediate consequences of such major disruptions have been a significant drop in income and high unemployment, or job losses, which have affected the household welfare. It has been reported that in 2020, the COVID-19 shock could translate into a decrease of 2.1 % of economic activity in the African region alone. This represents the continent's first recession in half a century and could push about 39 million people into extreme poverty (Arezki, Boly, and Koffi, 2021).

The interesting thing of the current study is that most of the previous studies reviewed stop at 2019 in their analysis like Abdullahi (2020) and Sanusi and Oderinde (2020). In view of the above the current study considered 2020 in the analysis and employed Structural VAR model

which none of the previous study has taken in to account. However, the main objective of the paper is to examine the innovations of Remittances on Economic Growth in Nigeria in the midst of Covid-19. The rest of the paper is organised as follows: literature review which is the second part of the paper, methodology in which the objectives of the paper could be achieved and is the third part of the paper, part four of the paper is presentation and analysis of the empirical findings and the final section concludes the paper.

2 THEORETICAL FRAMEWORKS

2.1 THE SELF-INTEREST THEORY

As its name suggest, the self-interest motive purports that migrants send money to households in their home country in the pursuit of personal gain. A possible reason for the self-interest motive is the intent of a migrant to return to his/her home country. The self-interest theory of remittances posits that migrants remit when they do not find investment opportunities in their host country or are unwilling to invest. Thus, "an obvious place to invest, at least part of his assets, is in the home country by buying property, land, financial assets, and so on. These assets may earn a higher rate of return than assets in the host country although their risk profile can also be greater. Lucas and Stark (1985) mentioned that when emigrants intend to return to their home country, they would send more remittances to ensure that their social assets, that is, relationships with family and friends are intact. The self-interest theory of remittances posits that migrants remit when they do not find investment opportunities in their host country or are unwilling to invest. Thus, "an obvious place to invest, at least part of his assets, is in the home country by buying property, land, financial assets, and so on. These assets may earn a higher rate of return than assets in the host country although their risk profile can also be greater. In turn, the family can administer, during the emigration period, those assets for the migrant, thus acting as a trusted agent." (Addison, 2004).

2.2 EMPIRICAL LITERATURES

Awode, Akpa, and Okwu (2021) explored the link between remittance, remittance volatility and macroeconomic performance to make a case for the potential impact of the COVID-19 pandemic using panel data. The study employed real gross domestic product (RGDP), consumption, investment, export and exchange rate as variables in the model. fixed effects and random effects model was adopted and found that remittance volatility exerts a negative but insignificant impact on RGDP, consumption, investment, export and exchange rate; while remittances itself has positive significant impact on RGDP, consumption and investment. Based on these findings, while any COVID-19-induced volatility in remittances flow into Africa may yield negative macroeconomic consequences, it is not likely to significantly affect the macroeconomic fundamentals of the most remittance-dependent African countries due to strong kinsman ship and the altruistic nature of remitting African migrants.

Titus, Akpa and Tochukwu (2021) evaluated the volatility using the symmetric GARCH (1, 1) univariate volatility model and include export, import and remittances in the model. The results revealed that a shock to exports during the COVID-19 pandemic was temporary and its recovery was quick. On the other hand, a shock to remittances was more enduring and persistent; and its variance reverted slowly. The study recommended that policies to promote export, especially of COVID-19 protective gears be implemented while efforts should be made to lower the cost of receiving remittances.

Akim, Ayivodji, and Kouton (2021) assessed the mitigating role of remittances during the adverse COVID-19 employment shock on Nigeria's food insecurity based on pre-COVID-19 and post-COVID-19 surveys. The results indicate that remittances are mitigating the negative consequences of COVID-19 employment shocks, especially in the short run. We find that 100% of the deterioration in food insecurity, owing to the shock, is offset by the remittances received.

While the adverse effects of the shock persist over time, this mitigation effect appears to be effective only at the early stages of the pandemic. Furthermore, the mitigation effect of remittances is heterogeneous regarding the origin of remittances, residence area, and poverty status. The study suggests that formal financial inclusion, capital ownership like livestock or rental earnings, amplify the mitigating effect of remittances.

Joshi, Mainali, Marasini, Acharya, and Adhikari (2021) synthesized the extant literature that reports the effects of COVID-19 on the Nepalese economy and implications for achieving UN Sustainable Development Goals. The study that found that the COVID-19 pandemic has created unprecedented challenges to achieve the country's committed United Nation's Sustainable Development Goals for Nepal. Further, the Covid-19 pandemic has created a unique “income shock” that is supposed to precipitate household food insecurity in developing economy like Nepal. Finding also indicated that the percentage of populations below poverty could rise even more than the present national reported value of 18% in the post-pandemic era.

Abdullahi (2020) examined the linkages between International migrant remittances and entrepreneurship development in Nigeria using Vector Autoregressive (VAR) approach. Variables employed in the study include personal Remittances (PR) New Business Density (NBDEN) and Self-employed. The study however finds a weak link between remittances and entrepreneurship development in Nigeria. In response to innovations in Personal remittances, there was a small negative effect on New business density (NBDEN) in the very short run, but this quickly becomes positive and persist throughout the forecast period. This positive response is however not significantly different from zero**.** The response of number of self-employed to changes in migrant remittances is negative and permanent. This negative response is

insignificant for the forecast horizon on the implication of Covid 19 on Migrants remittances and its consequences for entrepreneurship development.

Akpa, Awode, Okwu, and Oseni (2020) examined the effect of the GFC on remittances into 8 SSA countries from 1999 to 2019 using the Fixed Effects (FE) model. The study employed remittances, global financial crisis, per capita income, exchange rate, inflation and per capita income of remittances source income as variables. The results showed that the GFC had a positive and significant effect on remittances. Per capita income of migrant home country exerted a negative but insignificant effect on remittances, while per capita income in remittance source country had a positive and significant effect; the effects of exchange rate and inflation on remittances were positive and negative, respectively, but insignificant. Findings showed the effect of the GFC on remittances is robust to remittance measures and large country sample size. Sanusi and Oderinde (2020) examined the historical trends of remittances and import spending in Nigeria to determine the possible aftermaths of COVID-19 pandemic using time series data for the period of 1977- -2019, Vector Autoregressive model (VAR) model was used and the following variables were included in the model; migrants' remittance inflow, import of goods and service, real effective exchange rate and economic growth. The result indicates that a unit shock on remittances accounts for about 28% variation in import demand in the second period. Migrant's remittances and GDP per capita show a weak endogenous relationship. Remittances tend to be stable and not affected by the exchange rate. Thus, import demand may not reduce significantly due to fall in remittances as a consequence of COVID-19.

3. METHODOLOGY

The model of the study is adopted from the work of Sanusi et al (2020), it can be shown as

$GDP = F(REM, IM,\ REX, MIG)$ …….. (3.1)

The model is modified by adding foreign direct investment.

$$RGDP = F(REM, EXRATE,\ FDI) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.2)$$

Where the real Gross Domestic Product (RGDP) is used as a proxy that measured economic growth, REM is the remittances measured as personal remittances received per current US dollar, EXRATE is the official exchange rate is measured as real exchange rate, FDI is the foreign direct investment measured as foreign direct investment net inflows percentage to GDP.

3.1 VARIABLES MEASUREMENT

Variables	Measurement	Frequency	Source
Real Gross Domestic Product (RGDP)	Is used as a proxy that measured economic growth	2019m1 to 2020m12	Central Bank of Nigeria (CBN)
Remittances (REM)	Remittances measured as personal remittances received per current US dollar,	2019m1 to 2020m12	Global Economy data base
Exchange rate (EXRATE)	Is the official exchange rate is measured as real exchange rate	2019m1 to 2020m12	Central Bank of Nigeria (CBN)
Foreign direct investment (FDI)	Is the foreign direct investment measured as foreign direct investment net inflows percentage to GDP	2019m1 to 2020m12	Global Economy data base

Sources; Author`s Compilation 2021.

3.2 STRUCTURAL VECTOR AUTOREGRESSIVE (SVAR) MODEL

For the purpose of achieving the objectives of this research work, the study employed structural VAR which would determine the effects of remittances on economic growth in Nigeria during the Covid-19 pandemic. The goal of VAR analysis is to determine the interrelationship among the variables not to determine the parameters estimates Enders (20015). VAR is a system of equations which expresses each variable in the system to be a function of its own lags and lags of the remaining variables in the system. Thus, it treats all variables to be potentially endogenous.

VAR is an econometrics tool that shows the dynamic interrelationship between stationary variables. VAR is a model which consists only of endogenous variables and allows for the variables to depend not only on its own lags Enders (2015).

$$Y_t = b_{10} - b_{12}Z_t + \gamma_{11}y_{t-1} + \gamma_{12}Z_{t-1} + \varepsilon_{yt} \quad \text{.....(3.3)}$$

$$Z_t = b_{20} - b_{21}Y_t + \gamma_{21}y_{t-1} + \gamma_{22}Z_{t-1} + \varepsilon_{zt} \quad \text{..... (3.4)}$$

From equations (3.3) and (3.4), y_t and z_t are endogenous variables, b_{12} and b_{21} captures the contemporaneous effect of z_t on y_t and y_t on z_t respectively. The coefficients γ_i captures the lagged relationship between the variables, while ε_{yt} and ε_{zt} are structural errors.

$$B_0\, y_t = B_1\, y_{t-1} + B_2\, y_{t-2} + \ldots\ldots.. + B_P\, y_{p-1} + \Omega\varepsilon_t \text{.....(3.5)}$$

Where $\Omega$is the diag ($\sigma 1 \ldots\ldots \sigma n.$) and B_0 has a unity on its diagonal.

$$B_0^{-I}.B_0\, y_t = B_0^{-I}.B_1\, y_{t-1} + B_0^{-I}.B_2\, y_{t-2} + \ldots\ldots.. + B_0^{-I}.B_P\, y_{p-1} + B_0^{-I}.\Omega\varepsilon_t^{-v_t}\pi_1 \text{.....(3.6)}$$

$$Y_t = C(L)\varepsilon_t = C_0\epsilon_t + C_1\epsilon_{t-1} + \text{.....(3.7)}$$

Where the C_1 is the impulse responses of y_{t-1} to a unit shock in ε_t.

$$RGDP_t = \alpha_{10} - \alpha_{20}\, REM_t - \alpha_{30}\, EXRATE_t - \alpha_{40}\, FDI_t + \sum_{t-1}^{p}\beta_{10}^{t}\, RGDP_{t-1} + \beta_{10}^{t}\, REM_{t-1} + \beta_{12}^{t}\, EXRATE_{t-1} + \beta_{133}^{t}\, RGDP + \mu_t^{RGDP} \text{.....(3.8)}$$

$$REM_t = \alpha_{20} - \alpha_{30}\, RGDP_t - \alpha_{40}\, EXRATE - \alpha_{50}\, FDI + \sum_{t-1}^{p}\beta_{10}^{t}\, REM + \beta_{20}^{t}\, RGDP_{t-1} + \beta_{40}^{t}\, EXRATE_{t-1} + \beta_{50}^{t}\, FDI_{t-1}\, \mu_t^{REM} \text{.....(3.9)}$$

$$EXRATE \quad \alpha_{30} - \alpha_{40}\, RGDP_t - \alpha_{40}\, REM_t - \alpha_{50}\, FDI_t + \sum_{t-1}^{p}\beta_{30}^{t}\, EXRATE_{t-1} + \beta_{40}^{t}\, RGDP_{t-1} + \beta_{50}^{t}\, REM_{t-1} + + \beta_{50}^{t}\, FDI_{t-1}\, \mu_t^{EXRATE} \text{.....(3.10)}$$

$$FDI_t = \alpha_{40} - \alpha_{50}\, RGDP_t - \alpha_{60}\, REM_t - \alpha_{70}\, EXRATE_t + \sum_{t-1}^{p}\beta_{40}^{t}\, FDI_{t-1} + \beta_{50}^{t}\, RGDP_{t-1} + \beta_{60}^{t}\, REM_{t-1} + \beta_{70}^{t}\, FDI_{t-1}\ \mu_t^{FDI} \text{.....(3.11)}$$

$$\begin{bmatrix} RGDP \\ REM \\ EXRATE \\ FDI \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{bmatrix} \begin{bmatrix} 1 & A_{12} & A_{13} & A_{14} \\ A_{21} & 1 & A_{23} & A_{24} \\ A_{31} & A_{32} & 1 & A_{34} \\ A_{41} & A_{42} & A_{43} & 1 \end{bmatrix} \begin{bmatrix} RGDP_{t-1} \\ REM_{t-1} \\ EXRATE_{t-1} \\ FDI_{t-1} \end{bmatrix} + \begin{bmatrix} 1 & \alpha_{12} & a_{13} & a_{14} \\ 0 & 1 & \alpha_{23} & 0 \\ 0 & 0 & 1 & 0 \\ \alpha_{41} & 0 & \alpha_{43} & 1 \end{bmatrix} \begin{bmatrix} U_t^{RGDP} \\ U_t^{REM} \\ U_t^{EXRATE} \\ U_t^{FDI} \end{bmatrix}$$

$Where$

$$A = \begin{bmatrix} 1 & A_{12} & A_{13} & A_{14} \\ A_{21} & 1 & A_{23} & A_{24} \\ A_{31} & A_{32} & 1 & A_{34} \\ A_{41} & A_{42} & A_{43} & 1 \end{bmatrix}, C = \begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{bmatrix}, Z = \begin{bmatrix} RGDP \\ REM \\ EXRATE \\ FDI \end{bmatrix}, Z_{t-1} \begin{bmatrix} RGDP_{t-1} \\ REM_{t-1} \\ EXRATE_{t-1} \\ FDI_{t-1} \end{bmatrix}, U_t = \begin{bmatrix} U_t^{RGDP} \\ U_t^{REM} \\ U_t^{EXRATE} \\ U_t^{FDI} \end{bmatrix}$$

$$and\ a = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} such\ that\ U_t \sim iid\ (0, \alpha^2)$$

$z_t$is a 4 × 1 vector of dependent variables; Z_t is a 4 × 1 vector of lagged variables; A is a 4 × 4 matrix of the parameters to be estimated and identified with 1 as a diagonal elements, C is a 4 × 1 vector of constants, a is a 4 × 4 matrix of the coefficients of lagged variables and μ_t is a 4 × 1 vector of the structural/ orthogonal zed errors which are assumed to be serially uncorrelated with a mean of zero and a constant variance.

4 EMPIRICAL RESULTS AND DISCUSSION

4.1 DESCRIPTIVE STATISTICS

Table 4.1 Descriptive statistics

Statistics	LRGDP	LREM	EXRATE	LFDI
Mean	11.1122	8.2309	100.7601	0.0371
Median	11.0040	1.1909	106.4643	0.0514
Std. Dev.	0.4125	9.7409	100.7283	0.3616
Skewness	0.1663	0.4760	0.8887	-0.1315
Kurtosis	1.4783	1.3324	2.9947	2.3707
Jarque-Bera	4.0432	6.1459	5.2654	0.7752
Probability	0.1324	0.0462	0.0718	0.6786
Observations	24	24	24	24

Source: Researcher computation using E-views 10.

Table 4.1 shows the result of descriptive statistics of the study, it indicates that the standard deviations of the variables employed are not far away from their means except real gross domestic product (0.429461). The Skewness of the distribution shows positive values and less than one of real gross domestic product, remittances, and exchange rate, this implies that, these variables are skewed to the right and are normally distributed while foreign direct investment

indicates negative value, this means that foreign direct investment is skewed to the left and is normally distributed. The Kurtosis indicates that all the variables are normally distributed because their values are less than 3, this means these variables normally distributed. The Jarque-Bera test for normality is also estimated. The result indicates the rejection of null hypothesis of all the variables employed except remittances because their probabilities value are greater than 5% this means that real gross domestic product, foreign direct investment and exchange rate are normally distributed.

4.2 ZIVOT AND ANDREW UNIT ROOT TEST

Table 4.2 Zivot-Andrew Unit Root Test

	Level		**First difference**	
Variables	**Statistics**	**Break point**	**Statistics**	**Break point**
LRGDP	-2.6098	2014	-9.4066**	1994
LREM	-3.4123	2005	-8.1064**	1989
EXRATE	-2.8848	2013	-5.2890*	2008
LFDI	-2.9432	2008	-10.5150**	1995

Source: Researcher computation using E-views 10.

*Asterisk** and *indicates stationary at 5% and 10% level of significance.*

Table 4.2 depicts Zivot and Andrew unit root test, the test indicates that all the variables employed such as real gross domestic product, remittances, exchange rate and foreign direct investment are integrated of order one i.e. all the variables employed became stationary after taking their first difference, the break dates are 1994, 1989, 2008 and 1995. Thus we can infer that all the variables are non-stationary and integrated of order 1.

4.3 DIAGNOSTIC TEST

The diagnostic test is conducted to check the consistency and reliability of the estimated coefficients included in the model. Test such as Serial Correlation, Heteroscedasticity and normality test, SVAR stability tests are also conducted.

Table 4.3 post estimation test

Residual serial correlation LM tests		
Lags	LM-Stat	Prob
1	14.2837	0.5812
2	30.9069	0.0945
3	19.3932	0.2525
Residual heteroscedaticity tests		
Chi-square	Df	
148.0276	160	0.7419
Residual Normality tests		
Jarque-Bera	Df	
154.6901	8	0.0000

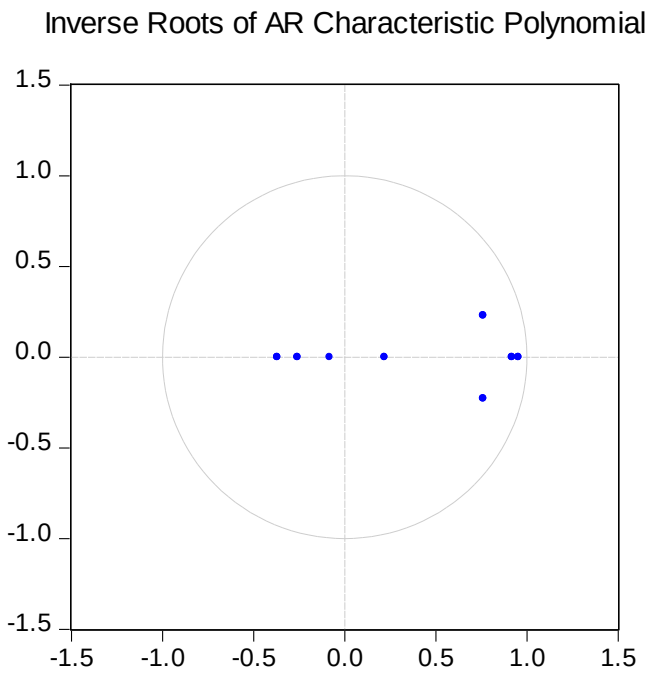
Source: Researcher computation using E-views 10.

From table 4.3, it is clear that the model is free from serial correlation and Hetroskedasticity because their p-values are greater than 5% while Normality test indicates that we cannot reject the null hypothesis because its p-value is less than 5%.

4.4 SVAR STABILITY TEST

The SVAR stability test was employed to check whether all the Eigen values are less than one or all the moduli are lies inside the unit circle. The figure 1 shows that all the moduli lies inside the unit circle. This indicates that SVAR model is stable, it implies that the impact of the shocks are finite and calculable. Hence, the SVAR satisfies its condition.

FIGURE 1 SVAR STABILITY TEST

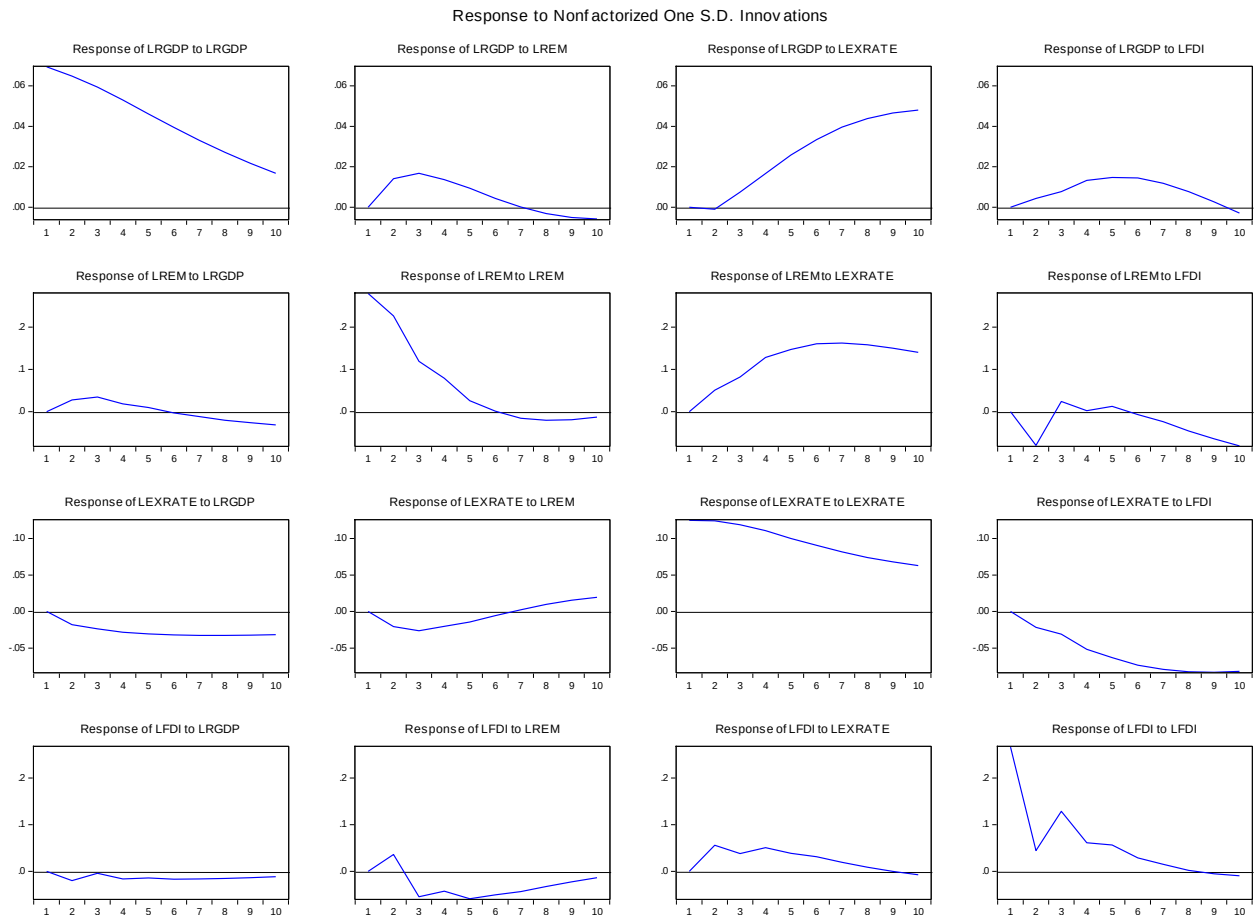


Source: Researcher computation using E-views 10.

4.5 Impulse Response Functions (IRF)

Impulse Response Functions (IRFs) are one of the useful tools of the unrestricted VAR approach for examining the interaction between the variables in this study. They reflect how individual variables respond to shocks from other variables in the system. When graphically presented, the IFRs give a visual representation of the behavior of variables in response to shocks. The results can be presented in the figure **4.2** below:

FIGURE 2 IMPULSE RESPONSE FUNCTIONS (IRF)



Source: Researcher computation using E-views 10.

According to the impulse response function presented above, one unit response of real gross domestic product shock to its own is positive throughout the horizon period. The responses of real gross domestic product to remittances is positive from period one to seven and quickly change to negative up to period 10. The shock effect of real gross domestic product to exchange rate is negative in period one to three and dies positively. The response of real gross domestic product to foreign direct investment is positive from period one to nine until the last period. The shock effect emanates from remittances to real gross domestic product is positive from period one to six and change to negative up to the last period, This is in line with the appriori expectation which established the existence of positive relationship between remittances and real gross domestic product in Nigeria. The response of remittances to exchange rate is positive

throughout the horizon period. The responses of remittances to foreign direct investment is negative in period one to two, positive in period three and die negatively. The one unit response of exchange rate to real gross domestic product is negative throughout the horizon period. The shock effect of exchange rate to remittances is negative in period one to seven and change to negative immediately up to period ten. The response of exchange rate to foreign direct investment is negative throughout the horizon period. The shock effect of foreign direct investment to real gross domestic product is negative throughout the period 10. The response of foreign direct investment to remittances is positive in period one to two and dies negatively. The response of foreign direct investment to exchange rate is positive in period one to eight and change to negative immediately.

4.6 VARIANCE DECOMPOSITION

The variance of real gross domestic product is always caused by 100 percent to itself in the first year. The fluctuation in real gross domestic product in both the short-run and long-run are explained by its own shock, approximately 93 percent in the 3 period and only to fall to 54 percent in periods 10. The shock attributable to remittances is very minimal, able to explain only 5 percent of remittance variability in the long-run. Also in the long-run exchange rate is 37 and foreign direct investment is 2 percent as a result of fluctuations in real gross domestic product. Remittances in the short run explained itself by 81 percent in first period, in 3 periods is 77 percent and it continues to fall in long run to 40 percent. The shock attributable to real GDP is 13 percent in the short run and 7 percent in the long run. Exchange rate in the short run explained itself by 92 percent but it continues to only fall to 63 percent in the long run. The shock of exchange rate to real GDP and remittances in the long run was 6 percent and 4 percent variability of exchange rate respectively. Foreign direct investment explained itself in the short run and long

run by 69 and 55 percent. In the long run, shocks attributable to real GDP, remittances and exchange rate are 4 percent, 15 percent and 24 percent respectively.

4.7 SVAR GRANGER CAUSALITY

The SVAR Granger causality shows that remittances granger cause real gross domestic product and real gross product granger cause remittances in Nigeria. Hence, the result detects a bi-directional causality running between remittances and real gross domestic product in Nigeria, this implies that remittances can be used for the prediction of real gross domestic product in Nigeria. Exchange rate granger cause real gross domestic product and real gross product granger cause exchange rate in Nigeria. The result also indicates bi-directional causality running between exchange rate and real gross domestic product in Nigeria. Foreign direct investment granger cause real gross domestic product and real gross product granger cause foreign direct investment in Nigeria, the result also indicates bi-directional causality between foreign direct investment and real gross domestic product.

4.8 DISCUSSION OF FINDINGS

The result shows that remittances has a positive impact on real gross domestic product in Nigeria, the positive finding is in line with the findings of Sanusi et al (2020) and Titus et al (2021) while counter the finding of Awode et al (2021). This is in line with the appriori expectation which established the existence of positive relationship between remittances and real gross domestic product in Nigeria. Exchange rate has negative effect on real gross domestic product in Nigeria. Foreign direct investment has a negative effect on real gross domestic product in Nigeria, this is contrary to appriori expectation which established the existence of positive relationship between foreign direct investment and real gross domestic product in Nigeria. The result from impulse response function shows that, the shock of remittances to real

GDP in the midst of to Covid-19 pandemic has impacted positively on real gross domestic product. This means that when remittances increase real gross domestic product will increase. During Covid-19 pandemic we have witnessed that most of economic activities were close down, people were lock down, in a nutshell everything were no longer moving the way it supposed to, so also remittances were no longer coming into country as before the outbreak because income of individual has stopped globally except for some few ones. Based on this we can infer that Covid-19 pandemic has reduce the remittances in Nigeria and this affected the real gross domestic product negatively.

5. CONCLUSIONS AND RECOMMENDATIONS

The paper investigate the innovation of remittances on Economic Growth in Nigeria in midst of Covid-19 using monthly time series data from 2019m1 to 2020m12. The results from the impulse response functions revealed that, the shock of remittances on real gross domestic product was found to be positive. Exchange rate has negative effect on real gross domestic product in Nigeria. Foreign direct investment has negative effect on real gross domestic product in Nigeria, this is contrary to appriori expectation which established the existence of positive relationship between foreign direct investment and real gross domestic product in Nigeria. The result from impulse response function shows that, the shock of remittances to real GDP in the midst of to Covid-19 pandemic has impacted positively on real gross domestic product. By implication when remittances increase real gross domestic product will increase. During Covid-19 pandemic we have witnessed that most of economic activities were close down, people were lock down, in a nutshell everything were no longer moving the way it supposed to, so also remittances were no longer coming into country as before the outbreak because income of individual has stopped globally except for some few ones. Based on this we can infer that Covid-

19 pandemic has reduce the remittances in Nigeria and this affected the real gross domestic product negatively. The study recommends that Nigerian government should provide means to make remittances cheaper as larger remittances inflows will make up for what may be lost as a result of COVID-19 pandemic and remittances should not be used for consumption purpose only rather for investment and consumption. Government should find a way to encourage Nigerians living abroad to continue sending remittances so as to improve economic growth.

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APPENDIX

	LRGDP	REM	EXRATE	LFDI
Mean	11.11222	8.23E+09	100.7601	0.037137
Median	11.00401	1.19E+09	106.4643	0.051476
Maximum	11.73773	2.43E+10	358.8108	0.762742
Minimum	10.44330	2424527.	0.617708	-0.709559
Std. Dev.	0.412506	9.74E+09	100.7283	0.361615
Skewness	0.166321	0.476097	0.888717	-0.131567
Kurtosis	1.478394	1.332404	2.994774	2.370790
Jarque-Bera	4.043224	6.145914	5.265499	0.775242
Probability	0.132442	0.046284	0.071881	0.678670
Sum	444.4888	3.29E+11	4030.406	1.485471
Sum Sq. Dev.	6.636273	3.70E+21	395701.7	5.099856
Observations	40	40	40	40

Null Hypothesis: LRGDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.483065	0.8189
Test critical values:	1% level	-4.205004	

	5% level	-3.526609
	10% level	-3.194611

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LRGDP)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LRGDP(-1)	-0.096520	0.065082	-1.483065	0.1465
C	1.018918	0.686297	1.484662	0.1461
@TREND("1980")	0.003529	0.002262	1.560196	0.1272

R-squared	0.065880	Mean dependent var	0.020706
Adjusted R-squared	0.015387	S.D. dependent var	0.103305
S.E. of regression	0.102507	Akaike info criterion	-1.645725
Sum squared resid	0.388787	Schwarz criterion	-1.519059
Log likelihood	35.91450	Hannan-Quinn criter.	-1.599927
F-statistic	1.304735	Durbin-Watson stat	1.299195
Prob(F-statistic)	0.283433		

Null Hypothesis: D(LRGDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.242348	0.0000
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LRGDP,2)
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LRGDP(-1))	-0.897039	0.123860	-7.242348	0.0000
C	-0.042397	0.026843	-1.579444	0.1230
@TREND("1980")	0.002425	0.001135	2.136669	0.0395

R-squared	0.600211	Mean dependent var	-0.010876

Adjusted R-squared	0.578000	S.D. dependent var	0.121891
S.E. of regression	0.079182	Akaike info criterion	-2.160322
Sum squared resid	0.225715	Schwarz criterion	-2.032356
Log likelihood	45.12628	Hannan-Quinn criter.	-2.114409
F-statistic	27.02373	Durbin-Watson stat	1.679081
Prob(F-statistic)	0.000000		

Null Hypothesis: LRGDP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.538407	0.7991
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.009720
HAC corrected variance (Bartlett kernel)	0.010790

Phillips-Perron Test Equation
Dependent Variable: D(LRGDP)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LRGDP(-1)	-0.096520	0.065082	-1.483065	0.1465
C	1.018918	0.686297	1.484662	0.1461
@TREND("1980")	0.003529	0.002262	1.560196	0.1272

R-squared	0.065880	Mean dependent var	0.020706
Adjusted R-squared	0.015387	S.D. dependent var	0.103305
S.E. of regression	0.102507	Akaike info criterion	-1.645725
Sum squared resid	0.388787	Schwarz criterion	-1.519059
Log likelihood	35.91450	Hannan-Quinn criter.	-1.599927
F-statistic	1.304735	Durbin-Watson stat	1.299195
Prob(F-statistic)	0.283433		

Null Hypothesis: D(LRGDP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*

Phillips-Perron test statistic		-6.946897	0.0000
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.005788
HAC corrected variance (Bartlett kernel)	0.007669

Phillips-Perron Test Equation
Dependent Variable: D(LRGDP,2)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LRGDP(-1))	-0.897039	0.123860	-7.242348	0.0000
C	-0.042397	0.026843	-1.579444	0.1230
@TREND("1980")	0.002425	0.001135	2.136669	0.0395

R-squared	0.600211	Mean dependent var	-0.010876
Adjusted R-squared	0.578000	S.D. dependent var	0.121891
S.E. of regression	0.079182	Akaike info criterion	-2.160322
Sum squared resid	0.225715	Schwarz criterion	-2.032356
Log likelihood	45.12628	Hannan-Quinn criter.	-2.114409
F-statistic	27.02373	Durbin-Watson stat	1.679081
Prob(F-statistic)	0.000000		

Null Hypothesis: LREM has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.906898	0.6324
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LREM)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LREM(-1)	-0.191710	0.100535	-1.906898	0.0643
C	1.337875	0.664458	2.013484	0.0514
@TREND("1980")	0.020845	0.011967	1.741893	0.0898

R-squared	0.089935	Mean dependent var	0.072359
Adjusted R-squared	0.040742	S.D. dependent var	0.306624
S.E. of regression	0.300313	Akaike info criterion	0.504053
Sum squared resid	3.336942	Schwarz criterion	0.630718
Log likelihood	-7.081050	Hannan-Quinn criter.	0.549851
F-statistic	1.828212	Durbin-Watson stat	1.896832
Prob(F-statistic)	0.174921		

Null Hypothesis: D(LREM) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.361270	0.0000
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LREM,2)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LREM(-1))	-1.057513	0.166242	-6.361270	0.0000
C	0.112418	0.107900	1.041873	0.3044
@TREND("1980")	-0.001445	0.004500	-0.321036	0.7500

R-squared	0.530070	Mean dependent var	-0.000228
Adjusted R-squared	0.503962	S.D. dependent var	0.449079
S.E. of regression	0.316286	Akaike info criterion	0.609466
Sum squared resid	3.601333	Schwarz criterion	0.737432
Log likelihood	-8.884578	Hannan-Quinn criter.	0.655379
F-statistic	20.30356	Durbin-Watson stat	1.973108
Prob(F-statistic)	0.000001		

Null Hypothesis: LREM has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.107078	0.5263
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.083424
HAC corrected variance (Bartlett kernel)	0.101351

Phillips-Perron Test Equation
Dependent Variable: D(LREM)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LREM(-1)	-0.191710	0.100535	-1.906898	0.0643
C	1.337875	0.664458	2.013484	0.0514
@TREND("1980")	0.020845	0.011967	1.741893	0.0898

R-squared	0.089935	Mean dependent var	0.072359
Adjusted R-squared	0.040742	S.D. dependent var	0.306624
S.E. of regression	0.300313	Akaike info criterion	0.504053
Sum squared resid	3.336942	Schwarz criterion	0.630718
Log likelihood	-7.081050	Hannan-Quinn criter.	0.549851
F-statistic	1.828212	Durbin-Watson stat	1.896832
Prob(F-statistic)	0.174921		

Null Hypothesis: D(LREM) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.361270	0.0000
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.092342
HAC corrected variance (Bartlett kernel)	0.092342

Phillips-Perron Test Equation
Dependent Variable: D(LREM,2)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LREM(-1))	-1.057513	0.166242	-6.361270	0.0000
C	0.112418	0.107900	1.041873	0.3044
@TREND("1980")	-0.001445	0.004500	-0.321036	0.7500

R-squared	0.530070	Mean dependent var	-0.000228
Adjusted R-squared	0.503962	S.D. dependent var	0.449079
S.E. of regression	0.316286	Akaike info criterion	0.609466
Sum squared resid	3.601333	Schwarz criterion	0.737432
Log likelihood	-8.884578	Hannan-Quinn criter.	0.655379
F-statistic	20.30356	Durbin-Watson stat	1.973108
Prob(F-statistic)	0.000001		

Null Hypothesis: EXRATE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.383693	0.9849
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXRATE)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXRATE(-1)	-0.031132	0.081137	-0.383693	0.7034
C	-5.716464	7.419138	-0.770502	0.4459
@TREND("1980")	0.855173	0.644151	1.327598	0.1924

R-squared	0.157700	Mean dependent var	8.956600
Adjusted R-squared	0.112170	S.D. dependent var	18.62358
S.E. of regression	17.54802	Akaike info criterion	8.639798
Sum squared resid	11393.52	Schwarz criterion	8.766464
Log likelihood	-169.7960	Hannan-Quinn criter.	8.685596
F-statistic	3.463666	Durbin-Watson stat	1.558460
Prob(F-statistic)	0.041796		

Null Hypothesis: D(EXRATE) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.778466	0.0023
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXRATE,2)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXRATE(-1))	-0.823064	0.172244	-4.778466	0.0000
C	-3.767670	5.970563	-0.631041	0.5320
@TREND("1980")	0.550578	0.264354	2.082729	0.0444

R-squared	0.391256	Mean dependent var	1.328690
Adjusted R-squared	0.357437	S.D. dependent var	21.90671
S.E. of regression	17.56043	Akaike info criterion	8.642977
Sum squared resid	11101.27	Schwarz criterion	8.770943
Log likelihood	-165.5380	Hannan-Quinn criter.	8.688890
F-statistic	11.56906	Durbin-Watson stat	1.831089
Prob(F-statistic)	0.000132		

Null Hypothesis: EXRATE has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.567917	0.9756
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	284.8380
HAC corrected variance (Bartlett kernel)	325.6346

Phillips-Perron Test Equation
Dependent Variable: D(EXRATE)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXRATE(-1)	-0.031132	0.081137	-0.383693	0.7034
C	-5.716464	7.419138	-0.770502	0.4459
@TREND("1980")	0.855173	0.644151	1.327598	0.1924

R-squared	0.157700	Mean dependent var	8.956600
Adjusted R-squared	0.112170	S.D. dependent var	18.62358
S.E. of regression	17.54802	Akaike info criterion	8.639798
Sum squared resid	11393.52	Schwarz criterion	8.766464
Log likelihood	-169.7960	Hannan-Quinn criter.	8.685596
F-statistic	3.463666	Durbin-Watson stat	1.558460
Prob(F-statistic)	0.041796		

Null Hypothesis: D(EXRATE) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.576834	0.0039
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	284.6480
HAC corrected variance (Bartlett kernel)	209.4745

Phillips-Perron Test Equation
Dependent Variable: D(EXRATE,2)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXRATE(-1))	-0.823064	0.172244	-4.778466	0.0000
C	-3.767670	5.970563	-0.631041	0.5320
@TREND("1980")	0.550578	0.264354	2.082729	0.0444

R-squared	0.391256	Mean dependent var	1.328690

Adjusted R-squared	0.357437	S.D. dependent var	21.90671
S.E. of regression	17.56043	Akaike info criterion	8.642977
Sum squared resid	11101.27	Schwarz criterion	8.770943
Log likelihood	-165.5380	Hannan-Quinn criter.	8.688890
F-statistic	11.56906	Durbin-Watson stat	1.831089
Prob(F-statistic)	0.000132		

Null Hypothesis: LFDI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.745902	0.2250
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LFDI)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LFDI(-1)	-0.359144	0.130793	-2.745902	0.0094
C	0.070792	0.096319	0.734978	0.4671
@TREND("1980")	-0.002517	0.004082	-0.616576	0.5414

R-squared	0.193701	Mean dependent var	-0.000279
Adjusted R-squared	0.148907	S.D. dependent var	0.307271
S.E. of regression	0.283472	Akaike info criterion	0.390397
Sum squared resid	2.892830	Schwarz criterion	0.518363
Log likelihood	-4.612741	Hannan-Quinn criter.	0.436310
F-statistic	4.324235	Durbin-Watson stat	2.465556
Prob(F-statistic)	0.020746		

Null Hypothesis: D(LFDI) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.13103	0.0000
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	
	10% level	-3.198312	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LFDI,2)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LFDI(-1))	-1.491571	0.147228	-10.13103	0.0000
C	0.144783	0.098884	1.464169	0.1521
@TREND("1980")	-0.006584	0.004101	-1.605474	0.1174

R-squared	0.745829	Mean dependent var	-0.004350
Adjusted R-squared	0.731305	S.D. dependent var	0.529992
S.E. of regression	0.274726	Akaike info criterion	0.329569
Sum squared resid	2.641597	Schwarz criterion	0.458852
Log likelihood	-3.261816	Hannan-Quinn criter.	0.375567
F-statistic	51.35124	Durbin-Watson stat	2.111287
Prob(F-statistic)	0.000000		

Null Hypothesis: LFDI has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.745902	0.2250
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.074175
HAC corrected variance (Bartlett kernel)	0.074175

Phillips-Perron Test Equation
Dependent Variable: D(LFDI)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LFDI(-1)	-0.359144	0.130793	-2.745902	0.0094
C	0.070792	0.096319	0.734978	0.4671
@TREND("1980")	-0.002517	0.004082	-0.616576	0.5414

R-squared	0.193701	Mean dependent var	-0.000279
Adjusted R-squared	0.148907	S.D. dependent var	0.307271
S.E. of regression	0.283472	Akaike info criterion	0.390397
Sum squared resid	2.892830	Schwarz criterion	0.518363
Log likelihood	-4.612741	Hannan-Quinn criter.	0.436310
F-statistic	4.324235	Durbin-Watson stat	2.465556
Prob(F-statistic)	0.020746		

Null Hypothesis: D(LFDI) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 13 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-18.76082	0.0000
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	
	10% level	-3.198312	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.069516
HAC corrected variance (Bartlett kernel)	0.012406

Phillips-Perron Test Equation
Dependent Variable: D(LFDI,2)
Method: Least Squares
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LFDI(-1))	-1.491571	0.147228	-10.13103	0.0000
C	0.144783	0.098884	1.464169	0.1521
@TREND("1980")	-0.006584	0.004101	-1.605474	0.1174

R-squared	0.745829	Mean dependent var	-0.004350
Adjusted R-squared	0.731305	S.D. dependent var	0.529992
S.E. of regression	0.274726	Akaike info criterion	0.329569
Sum squared resid	2.641597	Schwarz criterion	0.458852
Log likelihood	-3.261816	Hannan-Quinn criter.	0.375567
F-statistic	51.35124	Durbin-Watson stat	2.111287
Prob(F-statistic)	0.000000		

ZIVOT-ANDREW

Zivot-Andrews Unit Root Test
Date: 02/07/22 Time: 21:23

Sample (adjusted): 2019M02 2020M12
Included observations: 24
Null Hypothesis: LRGDP has a unit root with a structural
break in the intercept
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 2004

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-2.609790	0.008547
1% critical value:	-5.34	
5% critical value:	-4.93	
10% critical value:	-4.58	

* Probability values are calculated from a standard t-distribution
and do not take into account the breakpoint selection process

Zivot-Andrews Unit Root Test
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 24
Null Hypothesis: DLRGDP has a unit root with a structural
break in the intercept
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 1994

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-9.406663	0.000353
1% critical value:	-5.34	
5% critical value:	-4.93	
10% critical value:	-4.58	

* Probability values are calculated from a standard t-distribution
and do not take into account the breakpoint selection process

Zivot-Andrews Unit Root Test
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 24
Null Hypothesis: LREM has a unit root with a structural
break in both the intercept and trend
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 2005

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-3.412371	0.104778
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

* Probability values are calculated from a standard t-distribution
and do not take into account the breakpoint selection process

Zivot-Andrews Unit Root Test
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12

Included observations: 24
Null Hypothesis: DLREM has a unit root with a structural break in both the intercept and trend
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 1989

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-8.106442	0.095421
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

* Probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process

Zivot-Andrews Unit Root Test
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 24
Null Hypothesis: EXRATE has a unit root with a structural break in both the intercept and trend
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 2013

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-2.884846	0.277476
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

* Probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process

Zivot-Andrews Unit Root Test
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 24
Null Hypothesis: DECRATE has a unit root with a structural break in both the intercept and trend
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 2004

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-5.289053	0.092103
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

* Probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process

Zivot-Andrews Unit Root Test
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 24

Null Hypothesis: LFDI has a unit root with a structural break in both the intercept and trend
Chosen lag length: 1 (maximum lags: 4)
Chosen break point: 2008

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-2.943204	0.184448
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

* Probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process

Zivot-Andrews Unit Root Test
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 24
Null Hypothesis: DLFDI has a unit root with a structural break in both the intercept and trend
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 1995

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-10.51505	0.113130
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

* Probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process

Structural VAR Estimates
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 13 iterations
Structural VAR is just-identified

Model: Ae = Bu where E[uu']=I

A =

1	0	0	0
C(1)	1	0	0
C(2)	C(4)	1	0
C(3)	C(5)	C(6)	1

B =

C(7)	0	0	0
0	C(8)	0	0
0	0	C(9)	0
0	0	0	C(10)

	Coefficient	Std. Error	z-Statistic	Prob.

C(1)	1.743321	0.588476	2.962434	0.0031
C(2)	0.162251	0.319714	0.507487	0.6118
C(3)	-0.082548	0.576954	-0.143075	0.8862
C(4)	-0.047476	0.079437	-0.597660	0.5501
C(5)	-0.391977	0.143538	-2.730833	0.0063
C(6)	-0.707381	0.291757	-2.424558	0.0153
C(7)	0.069349	0.007955	8.717797	0.0000
C(8)	0.251572	0.028857	8.717797	0.0000
C(9)	0.123190	0.014131	8.717797	0.0000
C(10)	0.221559	0.025415	8.717797	0.0000
Log likelihood	75.01066			
Estimated A matrix:				
1.000000	0.000000	0.000000	0.000000	
1.743321	1.000000	0.000000	0.000000	
0.162251	-0.047476	1.000000	0.000000	
-0.082548	-0.391977	-0.707381	1.000000	
Estimated B matrix:				
0.069349	0.000000	0.000000	0.000000	
0.000000	0.251572	0.000000	0.000000	
0.000000	0.000000	0.123190	0.000000	
0.000000	0.000000	0.000000	0.221559	
Estimated S matrix:				
0.069349	0.000000	0.000000	0.000000	
-0.120898	0.251572	0.000000	0.000000	
-0.016992	0.011944	0.123190	0.000000	
-0.053684	0.107059	0.087142	0.221559	
Estimated F matrix:				
-0.228728	-0.008103	1.226334	-1.138458	
-2.093291	0.373916	2.788544	-3.160206	
-1.286933	-0.244506	1.590446	-2.136334	
0.011184	0.031509	0.081596	0.813250	

Variance Decomposition of LRGDP: Period	S.E.	LRGDP	LREM	LEXRATE	LFDI
1	0.069349	100.0000	0.000000	0.000000	0.000000
2	0.091581	97.39009	2.451452	0.003153	0.155306
3	0.106507	93.64350	4.994572	0.877929	0.484001
4	0.118508	88.30226	6.665582	3.778073	1.254090
5	0.129085	82.02633	7.327617	8.687426	1.958627
6	0.138961	75.49426	7.190426	14.87522	2.440090
7	0.148191	69.30510	6.659736	21.44957	2.585594
8	0.156716	63.76813	6.035264	27.71682	2.479783
9	0.164465	58.97380	5.482934	33.27432	2.268950
10	0.171435	54.88165	5.057942	37.95195	2.108459

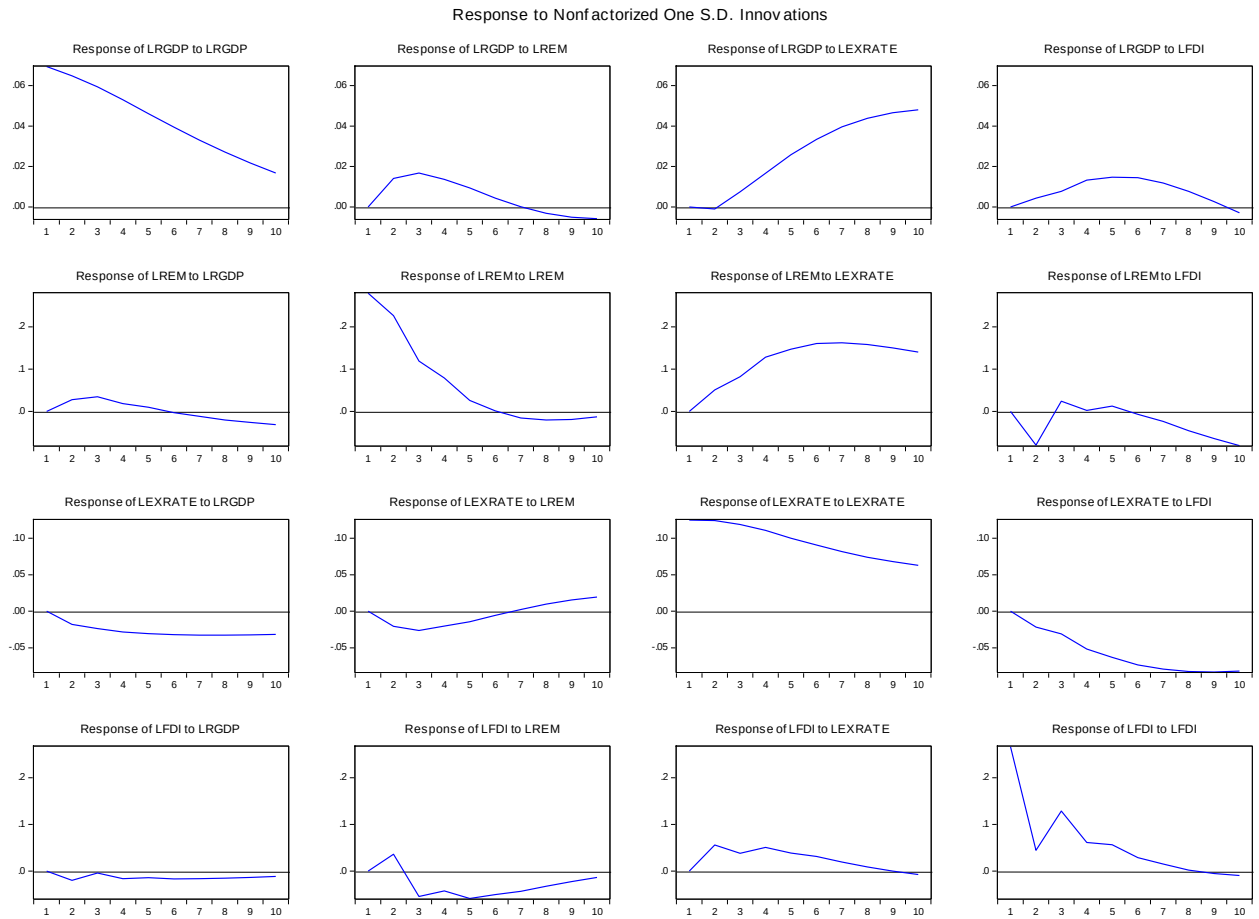
Variance Decomposition of LREM: Period	S.E.	LRGDP	LREM	LEXRATE	LFDI

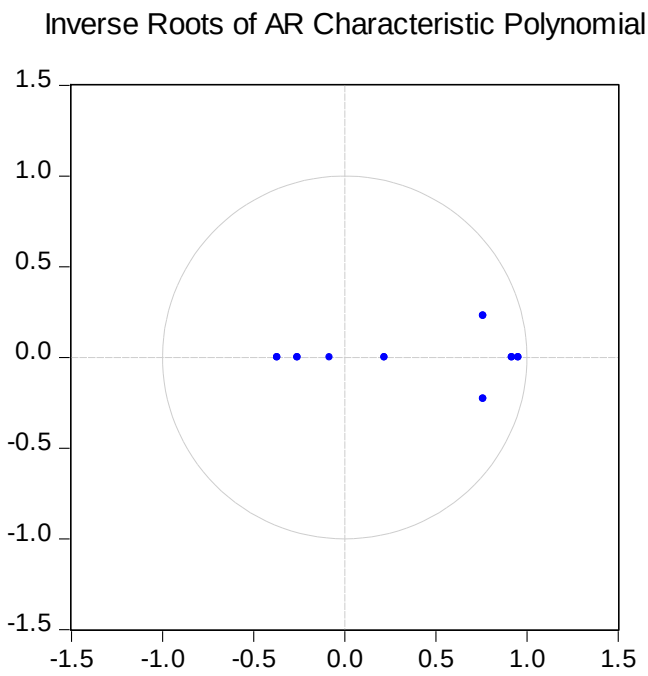
1	0.279114	18.76179	81.23821	0.000000	0.000000
2	0.343179	15.57797	80.20337	0.477251	3.741402
3	0.377817	13.60409	77.10723	5.916944	3.371733
4	0.408830	12.30627	70.11754	14.69463	2.881561
5	0.438137	11.02058	61.99225	24.41847	2.568696
6	0.465897	10.00355	54.91061	32.79861	2.287234
7	0.491020	9.210064	49.46416	39.10225	2.223531
8	0.513273	8.637651	45.44392	43.34381	2.574627
9	0.532783	8.243950	42.46325	45.89995	3.392848
10	0.550042	7.997103	40.14756	47.19084	4.664497

Variance Decomposition of LEXRATE: Period	S.E.	LRGDP	LREM	LEXRATE	LFDI
1	0.124929	1.849917	0.914011	97.23607	0.000000
2	0.173028	2.508487	1.268806	95.15740	1.065304
3	0.207637	2.881324	2.292206	92.56227	2.264201
4	0.234254	3.337441	3.265148	88.27541	5.122001
5	0.255300	3.782526	4.003647	83.70789	8.505935
6	0.273048	4.295024	4.386435	78.89841	12.42014
7	0.288356	4.842824	4.498883	74.31941	16.33888
8	0.301927	5.420753	4.425318	70.11728	20.03665
9	0.314073	6.009061	4.255983	66.40774	23.32722
10	0.325018	6.593627	4.051789	63.20306	26.15153

Variance Decomposition of LFDI: Period	S.E.	LRGDP	LREM	LEXRATE	LFDI
1	0.266507	4.057700	16.13739	10.69161	69.11330
2	0.288335	6.707528	17.57619	15.02858	60.68770
3	0.318086	5.644211	14.48866	18.67462	61.19251
4	0.330273	5.497416	13.50374	21.85292	59.14592
5	0.339521	5.228080	13.37601	23.49912	57.89679
6	0.344141	5.111385	13.78983	24.25241	56.84638
7	0.346632	5.044746	14.39344	24.39344	56.16837
8	0.347861	5.015534	14.90671	24.30239	55.77536
9	0.348597	5.000206	15.24429	24.20192	55.55358
10	0.349201	4.989791	15.40442	24.19922	55.40657

Cholesky Ordering: LRGDP LREM LEXRATE LFDI


Response to Nonfactorized One S.D. Innovations
Response of LRGDP to LRGDP
Response of LRGDP to LREM
Response of LRGDP to LEXRATE
Response of LRGDP to LFDI
Response of LREM to LRGDP
Response of LREM to LREM
Response of LREM to LEXRATE
Response of LREM to LFDI
Response of LEXRATE to LRGDP
Response of LEXRATE to LREM
Response of LEXRATE to LEXRATE
Response of LEXRATE to LFDI
Response of LFDI to LRGDP
Response of LFDI to LREM
Response of LFDI to LEXRATE
Response of LFDI to LFDI


Inverse Roots of AR Characteristic Polynomial
1.5
1.0
0.5
0.0
-0.5
-1.0
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-0.5
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1.0
1.5

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23

Dependent variable: LRGDP

Excluded	Chi-sq	df	Prob.
LREM	1.034782	2	0.5961
LEXRATE	0.826332	2	0.6616
LFDI	0.730787	2	0.6939
All	18.41685	6	0.0053

Dependent variable: LREM

Excluded	Chi-sq	df	Prob.
LRGDP	0.976134	2	0.6138
LEXRATE	8.474485	2	0.0144
LFDI	3.775663	2	0.1514
All	16.32265	6	0.0121

Dependent variable: LEXRATE

Excluded	Chi-sq	df	Prob.
LRGDP	1.020506	2	0.6003
LREM	0.651501	2	0.7220
LFDI	1.879286	2	0.3908
All	3.932761	6	0.6858

Dependent variable: LFDI

Excluded	Chi-sq	df	Prob.
LRGDP	0.244317	2	0.8850
LREM	2.973737	2	0.2261
LEXRATE	2.508987	2	0.2852
All	6.887855	6	0.3313

VAR Residual Serial Correlation LM Tests
Date: 10/23/21 Time: 12:17
Sample: 1980 2020
Included observations: 38

Null

hypothesis: No serial correlation at lag h

Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	14.28370	16	0.5776	0.891612	(16, 67.8)	0.5812
2	30.90694	16	0.0138	2.167904	(16, 67.8)	0.0945
3	19.39321	16	0.2488	1.254191	(16, 67.8)	0.2525

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	14.28370	16	0.5776	0.891612	(16, 67.8)	0.5812
2	62.38648	32	0.0010	2.381168	(32, 68.0)	0.0014
3	74.26571	48	0.0089	1.820291	(48, 56.0)	0.0158

*Edgeworth expansion corrected likelihood ratio statistic.

VAR Residual Heteroskedasticity Tests (Levels and Squares)
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23

Joint test:

Chi-sq	Df	Prob.
148.0276	160	0.7419

Individual components:

Dependent	R-squared	F(16,21)	Prob.	Chi-sq(16)	Prob.
res1*res1	0.313956	0.600642	0.8492	11.93032	0.7488
res2*res2	0.386668	0.827449	0.6461	14.69337	0.5472
res3*res3	0.486650	1.244235	0.3147	18.49270	0.2958
res4*res4	0.279079	0.508088	0.9144	10.60500	0.8332
res2*res1	0.341793	0.681554	0.7810	12.98813	0.6736
res3*res1	0.236285	0.406072	0.9647	8.978820	0.9143
res3*res2	0.421285	0.955456	0.5296	16.00883	0.4523
res4*res1	0.374168	0.784709	0.6862	14.21839	0.5824
res4*res2	0.338662	0.672113	0.7893	12.86916	0.6823
res4*res3	0.426477	0.975985	0.5119	16.20611	0.4387

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: Residuals are multivariate normal
Date: 02/07/22 Time: 21:23
Sample (adjusted): 2019M02 2020M12
Included observations: 23

Component	Skewness	Chi-sq	df	Prob.*
1	-1.659751	17.44690	1	0.0000
2	0.764324	3.699882	1	0.0544
3	2.079685	27.39222	1	0.0000
4	-0.653577	2.705368	1	0.1000
Joint		51.24438	4	0.0000

Component	Kurtosis	Chi-sq	df	Prob.
1	8.058313	40.51201	1	0.0000
2	3.322328	0.164501	1	0.6850
3	9.260732	62.06154	1	0.0000
4	3.668550	0.707685	1	0.4002
Joint		103.4457	4	0.0000

Component	Jarque-Bera	df	Prob.
1	57.95891	2	0.0000
2	3.864383	2	0.1448
3	89.45376	2	0.0000
4	3.413053	2	0.1815
Joint	154.6901	8	0.0000

*Approximate p-values do not account for coefficient Estimation