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Macroeconomic Consequences of Covid-19 in a Small Open Economy: An Empirical Analysis of Nigeria

(Kesan Makroekonomi Covid-19 dalam Ekonomi Terbuka Kecil: Analisis Empirikal Nigeria)

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ABSTRACT

Nigeria is a small open economy with a high level of external dependency especially on the export of crude oil for foreign earnings and government revenue and import of consumables goods including pharmaceutical products. Currently, China and USA contribute more than 35% of Nigerian total import and in addition with Euro area constitute top export destinations of Nigerian crude oil. Studies in the past have investigated the vulnerability of Nigerian economy to external shocks, however, the emerging shocks from global economy due to COVID-19 seems unprecedented. Thus, it is imperative to preemptively examine the likely spillover effects of COVID-19 pandemic to a small open economy like Nigeria based on shocks to strategic trade partners. Given this background, this study investigates the macroeconomic consequences of COVID-19 in China, the Euro area and United States of America (USA) in Nigeria using Global Vector Autoregressive (GVAR) approach. This modelling approach provides an opportunity to analyze international macroeconomic transmission of shocks and spillovers between different countries. It also provides a framework to offer adequate tools to deal with the curse of dimensionality that may arise during the analysis. Macroeconomic variables such as exchange rate, economic growth, inflation rate, trade flows and consumers' spending were employed from Nigeria and other COVID-19 infected partner countries to build the GVAR model. Similarly, variable such as oil price and world commodity price index served as global variables. These variables were introduced quarterly to obtain stable behavioural interactions. Subsequently, simulations were performed to capture economic reality of COVID-19 and policy reactions in COVID-19 infected partner countries. The study identified output and inflation shocks in USA and China as important external shocks to the Nigerian economy however, oil price shocks constitute the biggest external threat to the economy during and post COVID-19 era.

Keywords: Macroeconomics, GVAR, Shock, COVID-19
JEL Codes: E0, I10, I150

ABSTRAK

Nigeria adalah sebuah negara ekonomi terbuka kecil dengan tingkat kebergantungan luaran yang tinggi terutama pada eksport minyak mentah untuk pendapatan luar negara dan hasil kerajaan dan import barang pakai habis termasuk produk farmaseutikal. Pada masa kini, China dan Amerika Syarikat menyumbang lebih daripada 35% daripada jumlah import Nigeria dan sebagai tambahan dengan kawasan Euro merupakan destinasi eksport utama minyak mentah Nigeria. Kajian pada masa lalu telah meneliti kerentanan ekonomi Nigeria terhadap kejutan luaran, namun, kejutan ekonomi global yang timbul akibat COVID-19 nampaknya belum pernah terjadi sebelumnya. Oleh itu, adalah mustahak untuk mengkaji secara terlebih dahulu kemungkinan kesan limpahan pandemik COVID-19 kepada ekonomi terbuka kecil seperti Nigeria berdasarkan kejutan terhadap rakan perdagangan strategik. Dengan latar belakang ini, kajian ini mengkaji akibat makroekonomi COVID-19 di China, kawasan Euro dan Amerika Syarikat (AS) di Nigeria menggunakan pendekatan Global Vector Autoregressive (GVAR). Pendekatan pemodelan ini memberi peluang untuk menganalisis pengaliran kejutan dan limpahan makroekonomi antarabangsa antara negara yang berbeza. Ini juga menyediakan kerangka kerja untuk menawarkan alat yang memadai untuk menangani kutukan dimensi yang mungkin timbul semasa analisis. Pemboleh ubah makroekonomi seperti kadar pertukaran, pertumbuhan ekonomi, kadar inflasi, aliran perdagangan dan perbelanjaan pengguna digunakan dari Nigeria dan negara rakan yang dijangkiti COVID-19 lain untuk membina model GVAR. Begitu juga, pemboleh ubah seperti harga minyak dan indeks harga komoditi dunia berfungsi sebagai pemboleh ubah global. Pemboleh ubah ini diperkenalkan secara suku tahun untuk mendapatkan interaksi tingkah laku yang stabil. Seterusnya, simulasi dilakukan untuk mendapatkan realiti ekonomi COVID-19 dan reaksi dasar di negara rakan yang dijangkiti COVID-19. Kajian ini mengenal pasti kejutan output dan inflasi di Amerika Syarikat dan China sebagai kejutan luaran yang penting bagi ekonomi Nigeria, namun kejutan harga minyak merupakan ancaman luaran terbesar bagi ekonomi semasa dan pasca COVID-19.

Kata kunci: Makroekonomi; GVAR; kejutan; COVID-19

INTRODUCTION

COVID-19 was discovered in a city called Wuhan in China and it started with a reported cluster of 27 pneumonia cases and has now been detected in 209 locations internationally, including the United States and 33 African countries. There are about 39 countries that have passed the threshold of 100 confirmed cases including two African countries. Currently, there are 5.5 million confirmed cases globally with accompanied 346,342 deaths including 3,078 people from Africa (WHO,2020). As of May 24, 54 African countries have reported COVID-19 cases. Nigeria, in particular, has recorded 8068 confirmed cases. The consequence of COVID-19 in African countries can be better imagined given the prevailing weak health institutions and response capacity in the continent. Studies in the past have investigated the vulnerability of Nigerian economy to external shocks, however, the emerging shocks from global economy as a result of COVID-19 seems unprecedented. Thus, it is imperative to preemptively examine the likely spillover effects of COVID-19 pandemic to a small open economy like Nigeria based on shocks to strategic trade partners

In response to this global pandemic, countries have imposed restriction on movement of people and goods both within and outside the country. This has impacted heavily on different sectors of the economy and business sizes. Several flights have been cancelled, supply chains disrupted and businesses have been closed mostly as a result of government bans and business policies. This has caused a substantial loss of wages for workers and business owners majorly in the informal sector of the economy. This has also created global apprehension and tension regarding what might be the economic consequences of this pandemic. According to a survey conducted by PricewaterhouseCoopers (PwC) for chief financial officers (CFOs) of companies during the week of March 9, 2020, in the U.S. and Mexico indicates that 80 per cent are concerned the global health emergency created by coronavirus will lead to a global economic recession.

Similarly, Economists polled by Reuters on March 3-5 2020, reported that COVID-19 outbreak will likely halve China's economic growth in this quarter compared with the recent quarter. Apart from these expectations, the economic reality of COVID-19 is already manifesting. China's exports declined by 17.2 % in January and February, Eurostoxx 50 is down by almost 25 per cent as at 10th of march, Brent Crude declined by over 20% in single day, the Dow is down more than 24% for March and the S&P 500 has dropped 22% month to date and the index is down about 17% from its record high on February 19. All of these have generated both demand and supply shocks reverberating across the global economy.

To stem this sequence of economic shocks, countries across the globe have started to initiate both fiscal and monetary policies to absorb the unanticipated economics shocks orchestrated by COVID-19 in an effort to stabilize their economy. Currently, European Central Bank announced €750 a billion programmes to buy government and corporate debt and US Federal Reserve has slashed rates by 0.5% and introduced other quantitative easing approaches. Similarly, the Canadian government has concluded arrangement to provide up to $27 billion in direct support to Canadian workers and businesses. In Nigeria, Central Bank of Nigeria (CBN) has provided some policy responses such as slashing of interest rate on intervention facilities from 9% to 5% and the establishment of N50 billion targeted credit facilities.

Nigeria is a typical example of a small open economy with the external sector accounting for 33% of total GDP in 2018 according to World to bank trade openness report. In more specific terms, 75% of government, revenues come from oil export Nweze and Edame (2016) and the sector contributed 88% of Nigeria's foreign exchange earnings (NBS report 2018). Apart from the export, Nigerian imports grew by 26.3% in 2019 and 54.2 per cent were manufactured products and 43% of these products originated from Asia a continent currently ravaged with COVID-19. Studies in the past have examined the vulnerability of the Nigeria economy to external shocks via different channels with oil being the prominent channel explored so far (Madujibeya, 1976, Akinlo 2012, &Oyelami and Olomola, 2016). However, none of these studies was able to capture the array of demand and supply shocks reverberating across the global economy as a result of COVID-19 on the Nigerian economy.

Moving away from trade. Globally, financial markets have produced evidences to indicate response to COVID-19 pandemic. Global stock indices are experiencing unusual turbulence and Nigerian Stock Market is not in any way insulated from this contagious effect. COVID-19 has led to serious uncertainty in the market and created capital flows reversal in many emerging and frontier markets including Nigeria. The NSE-All Share decreased 4951 points or 18.43% since the beginning of 2020 and a further sharp decline in the market in the month of march coincides with the global rampage of COVID-19. Due to uncertainty beclouding the global economy as reflected in the global stock market, studies are ongoing and some concluded in an attempt to investigate the general macroeconomic outcomes of COVID-19(Ozili & Arun, 2020; Adesoji, Farayibi & Simplice, 2020).

Since the report of the first incidence in the country on 27th of February, the investors in the stock market have lost about N 2.51 trillion within six weeks (NSE report 2020). Studies have been springing up on the macroeconomic effect of COVID-19, however, most of these studies are at the global level which may not make adequate provisions for country-specific situations. Thus, a study of this nature is very critical

for an externally dependent and vulnerable economy like Nigeria. Specifically, the study aims to address the following issues.

1. 6.7% decline in China's economy as projected by IMF
2. 6.0% decline in US economy
3. 6.0 % decline in EU economy
4. Oil price of $20 per barrel

LITERATURE REVIEW

The outbreak of Severe Acute Respiratory Syndrome (SARS) epidemic in the year 2003 which spread across 26 nationalities and caused more than 8000 cases necessitated another round of investigations on the economic effect of the epidemic on the economy. Starting with the study by Chou, Kuo & Peng (2004). The study, using a multiregional computable general equilibrium model examines the economic effect of SARS outbreak on the economy of Taiwan, mainland China and Hong Kong. The study finds that the outbreak would cause a loss of 0.67% per cent in Taiwan, 0.20% per cent in mainland China, and 1.56 per cent in Hong Kong respectively in service and manufacturing sector in the short-term and additional 1.6% in China's GDP in the long-term. A similar study in the region designed specifically for Hong Kong by Siu & Wong (2004) using descriptive analysis concludes that the SARS outbreak only affects the demand side of the economy and supply side. A related study by Hai, Zhao, Wang & Hou (2004) provides similar evidence. While many of these studies are either region or sector-specific, study by Lee & McKibbin (2004, April) provides a global economic cost of SARS epidemic based on the G-Cubed global model analysis. G-Cubed model has the inherent capability to incorporates rational expectations and this forward-looking feature makes the model more appropriate for predicting the behaviour of economic agents. The study finds that in spite of few cases and deaths from SARS epidemic, it had a significant impact on the global economy and the ripple effects transcended beyond countries of the outbreak.

In furtherance of this review, Bloom, De Wit, & Carangal-San Jose (2005) perform two simulations using Oxford Economic Forecasting (OEF) global model to estimate the economic impact of Avian Flu on the Asian economy. The two assume a relatively mild pandemic with a rate of 20% and 0.5% mortality. The study finds that the pandemic will halt economic growth in the region and cause a significant reduction in trade. A study by Lee and McKibbin (2003) gives similar shreds of evidence. McKibbin and Sidorenko (2006) focusing on the global economy, investigate the global economic implication of pandemic influenza outbreak through a range of scenarios.

Across all the scenarios from mild to severe, the study presents convincing evidence to show that the best-case scenario will cause 0.8% a decline in global GDP while the worst-case scenario will cause GDP loss of $US4.4 trillion. The major line that runs through all of the studies is that pandemic attracts economic cost the scale of the cost capture in different study depends on the scope of the study and method deploy for the analysis. One of the most recent studies in this area is McKibbin & Fernando (2020). The study building on McKibbin and Sidorenko (2006), examine the likely economic implications of COVID-19 exploring with seven different scenarios using global CGE modelling techniques. The study finds that a contained outbreak could impact the global economy significantly at least in the short run. Many of these studies are global and very few of them focuses on African countries and none has Nigeria as a country of reference thus study of this nature is crucial for a fragile economy like Nigeria.

The importance of US and European economies to macroeconomics performances of small countries around the world have been documented in the literature. In recent time, Chinese economy has been exerting so much influence on small economies especially in Africa and it is becoming increasingly noticeable. Study by Georgiadis (2016) assesses the global spillovers from identified US monetary policy shocks to other countries using global VAR model. The study established that monetary policy shocks in US generates sizable output spillovers to other economies especial small countries with no shock absorbers. Similar study by Kalemli-Özcan (2019) provided close evidences. In the case of China and Euro area, study by Sznajderska & Kapuściński (2020) and Kucharčuková, Claeys & Vašíček (2016) explain the relevance of policy spillover from these regions to macroeconomic activities of other countries. Study by Kinateder, Campbell & Choudhury (2021) provides evidence to support the existence of extreme fear amongst the investors during COVID-19 and this be considered as a strong channel of shock propagation among countries. Another study by Hassan, Rabbani, & Abdulla (2021) in the middle east and north Africa documents evidence of negative shock propagation in the region. Based on these evidences, it is critical for a small open economy to estimate potential shocks especially a huge shock expected from COVID-19 to be transmitted through these critical trade partners. This is the focus of this study.

METHODOLOGY

This study involves the use of Global Vector Autoregressive (GVAR) model covering a period of 1979Q2-2016Q4. The data of the domestic variables for the countries in the original GVAR model was extracted and used. This version of the GVAR dataset (2016

Vintage) revises and extends up to 2016Q4. The data as presented in the GVAR database cover 33 countries and Nigeria is not included. In an attempt to cater for Nigeria in this study, Nigerian data comprise of GDP, Inflation rate, Short term Interest rate and the Exchange rate were included in the GVAR database. Nigerian data were sourced from the International Monetary Fund (IMF, 2019), and World Development Indicator (WDI, 2019). Specifically, data for trade flows, exchange rate measured as the value of a domestic currency against US dollars and short-term interest rate measured as the interest of government treasure bills were obtained from the International Monetary Fund and real GDP data measured in US dollars was sourced from World Development Indicator. For a comprehensive discussion on variable their construction on Vintage GVAR database see Mohaddes & Raissi (2018).

THE GVAR MODEL

In the literature of Vector Autoregression (VAR), large variables required for analysis in this study can be better approached using one of augmented VARs, Bayesian VARs and the global VARs. The handy nature and intuitive appeals of GVAR has made it more attrative (Pesaran and Chudik, 2014). The GVAR as a macroeconomic model is a global model consisting of individual country-specific VARX models. These individual country-specific VARX models are first solved independently and later stacked together to form the global VAR model which is finally solved as an interdependent system. Each VARX model in GVAR model comprises of domestic variables and weakly exogenous foreign variables. These foreign variables are constructed using domestic variables of other countries and connected together using international trade flows between countries as the weight. Other flows such as financial flows could as well be employed but Dees, Mauro, Pesaran, & Smith (2007) have shown that trade flows provide the best approach to capture expected international linkages inherent in GVAR. Usually, the GVAR model also includes global variables such as the price of raw materials, oil prices world and price of metals.

Based on the aforementioned variables, country-specific VARX* model was constructed. In each VARX model, domestic variables, foreign variables, and global variables are designed to reflect time trend. The variables employed in each VARX* models are:

$$q_{it} = In\left(GDP_{it} / CPI_{it}\right).$$
$$\mathrm{p}_{it} = In\left(CPI_{it}\right) - In\left(CPI_{i,t-1}\right).$$
$$eq_{it} = In\left(Eq_{it}\right).$$
$$ep_{it} = In\left(Ep_{it}\right).$$
$$i_{it} = In\left(i_{it}\right).$$
$$l_{it} = In\left(r_{it}\right).$$
$$P_t^W = In\left(P_t^W\right).$$
$$P_t^0 = In\left(P_t^0\right).$$

where:

GDP_{it} = gross domestic product of country *i* during period *t* (in US dollar currency)
CPI_{it} = Inflation country *i* at time *t* (with the base yeart 100)
eq_{it} = equity price
ep_{it} = exchange rate of country in US dollars
i_{it} = short-term interest rate
l_{it} = long-term interest rate
p_t^W = world price of raw materials
P_t^0 = world oil price
p_t^m = world price of metals

n our GVAR model, US is indexed as country 0, and the exchange re of the US — E_{0t}—is taken to be 1. Each VARX* model is embedded with domestic variables, represented by $\left(q_{it}, p_{it}, eq_{it}, ep_{it}, i_{it}, l_{it}\right)$, foreign variables represented by $\left(q_{it}^*, p_{it}^*, eq_{it}^*, ep_{it}^*, i_{it}^*, l_{it}^*\right)$ and global variables (p_t^o, p_t^c, p_t^m). The global variables are oil price (p_t^o), World Commodity Price Index (p_t^c) and World Price of Metals (p_t^m). In a typical GVAR model, the interrelationship between economies follows three connected channels: They are X_{it} on X_{it}^* and X_{it-m}^*, which depict the influence of foreign variables both current and lag on domestic variables, $d = \left(p_t^W, p_t^o \text{ and } p_t^m\right)$ which shows the influence of common global variables on domestic variables and nonzero contemporaneous dependence of shocks in country i on the shocks in country j, measured via the cross-country covariances $\sum_{ij}$. The foreign variables are assumed to be weak exogenous variables. Usually, in VARX* models foreign variables are trade weighted macroeconomic variables (denoted by an "*") and constructed as follow:

$$\pi_{it}^* = \int_{j=0}^{N} w_{ij}\pi_{jt} \quad e_{it}^* = \int_{j=0}^{N} W_{ij}e_{jt}, \qquad (1)$$

$$q_{it}^* = \int_{j=0}^{N} w_{ij}q_{jt}, \; r_{it}^* = \int_{j=0}^{N} w_{ij}r_{jt} \qquad (2)$$

The weights w_{ij} for $i, j = 0, 1, \ldots, N$ are trade volume used as weights between country *i* and country *j* which we constructed using the simple average of annual total trade of a country during the 1980–2016 period. w_{ii} is 0 for any country *i*. They were constructed based on the following assumptions: that the trade variables are integrated of order one I(1), the foreign variables are weakly exogenous, and the parameters of VARX* models remain stable over time. Also, in individual VARX* $\left(p_i, q_i\right)$ models, given that p_i denotes the lag order of endogenous variables and q_i denotes the lag

TABLE 1. Unit root of Domestic and Foreign Variables

Country Nigeria	Augmented Dickey-Fuller			Weighted-Symmetric Augmented Dickey-Fuller		
	Levels	First diff.	Status	Levels	First diff.	Status
Real GDP	-3.486	-2.996	I(0)	-0.836	-2.742	I(1)
Inflation	-3.719	-7.460	I(0)	-3.967	-7.638	I(0)
Exchange rate	-1.357	-11.355	I(1)	-1.595	-11.355	I(1)
Interest rate	-3.148	-6.791	I(1)	-2.213	-6.925	I(1)
Foreign GDP	-1.689	-5.987	I(1)	-1.963	-6.036	I(1)
Foreign Infl.	-2.770	-9.670	I(1)	-2.977	-9.819	I(1)
Foreign Exch.	-2.081	-7.663	I(1)	-2.321	-7.654	I(1)
Foreign Int.	-3.140	-9.660	I(1)	-2.715	-9.836	I(1)

The critical values for the ADF and WS tests at 5% are 3.45 and 3.24

TABLE 2. Results of the co-integration tests on the endogenous and exogenous variables

H_0	H_1	Statistics	H_0	H_1	Statistics
	Nigeria			China	
Maximal eigenvalue statistics			Maximal eigenvalue statistics		
r=0	r=1	186.0	r=0	r=1	74.5
r ≤ 1	r=2	101.9	r ≤ 1	r=2	55.6
	r=3	59.3		r=3	40.5
	r=4	21.8		r=4	21.2
Trace Statistics			Trace Statistics		
r=0	r=1	136.9	r=0	r=1	192.0
r ≤ 1	r=2	99.1	r ≤ 1	r=2	117.0
	r=3	64.9		r=3	61.7
	r=4	33.8		r=4	21.2
H_0	H_1	Statistics	H_0	H_1	Statistics
	United States			Euro	
Maximal eigenvalue statistics			Maximal eigenvalue statistics		
r=0	r=1	146.0	r=0	r=1	90.7
r ≤ 1	r=2	79.0	r ≤ 1	r=2	50.3
	r=3	47.8		r=3	42.4
	r=4	34.0		r=4	30.0
	r=5	32.58		r=5	27.2
	r=6	16.8		r=6	12.3
Trace Statistics			Trace Statistics		
r=0	r=1	356.3	r=0	r=1	253.2
r ≤ 1	r=2	210.3	r ≤ 1	r=2	162.5
	r=3	131.2		r=3	112.1
	r=4	83.4		r=4	69.6
	r=5	49.3		r=5	39.5
	r=6	16.8		r=6	12.3

Notes: The null hypothesis, H0, of no cointegration is rejected when the value of the trace and maximal eigen statistics is greater than the critical values at 5% significance level.

order of exogenous variables selected. Then, country-specific VARX*(1, 1) models can be designed as follow:

$$X_{it} = \delta_{i0} + \delta_{i1}t + \Phi_i X_{i,t-1} + \Lambda_{i0}X_{it}^{*} + \Lambda_{i1}X_{i,t-1}^{*} + \Gamma_{i0}d_t + \Gamma_{i1}d_{t-1} + \varepsilon_{it} \quad (3)^{0}$$

In the equation, t denotes linear time trend, in line with Pesaran et al. (2004) assumption of weak exogeneity of foreign variables, it implies that each country, with the exception of the US, is considered as a small open economy. Consequently, the global variables, $d = \left(p_t^o \;\; p_t^c \, and \, p_t^m \right)$, were treated as endogenous in the US model.

Furthermore, it is of great essence to test for the assumption of weak exogeneity of foreign country-specific variables. According to Pesaran, Schuermann, & Weiner, (2004), to assume star variables are weakly exogenous, three underlining conditions are required. The global model is expected to be stable; the weights of foreign-specific variables are expected to be relatively small and the individual country-specific shocks are expected to be cross-sectionally weakly correlated. In most cases, these conditions are not subjected to direct tests however, the implications of these assumptions are tested through the non-significance of co-integrating relationship.

FINDINGS

Sequel to careful estimation of our model, the necessary findings are highlighted as follow.

UNIT ROOT TEST

In Table 1, the results of unit roots tests are presented following Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979) and Weighted-Symmetric Augmented Dickey-Fuller (WS) () procedures. In the results, all domestic and foreign variables in Nigerian VARX are presented. All variables were tested for unit roots in their levels and first differences. The tests show that all variables are non-stationary at levels except domestic Real GDP and Inflation in Nigeria. However, they are all stationary at first difference indicating that the hypothesis of non-stationarity is rejected at the first difference and the variables are I (1). Given this situation, the test for the co-integration relationship is required. Subsequently, the test for the existence of co-integrating relationship among Nigerian domestic variables and their foreign counterparts were performed and the results are presented in Table 2.

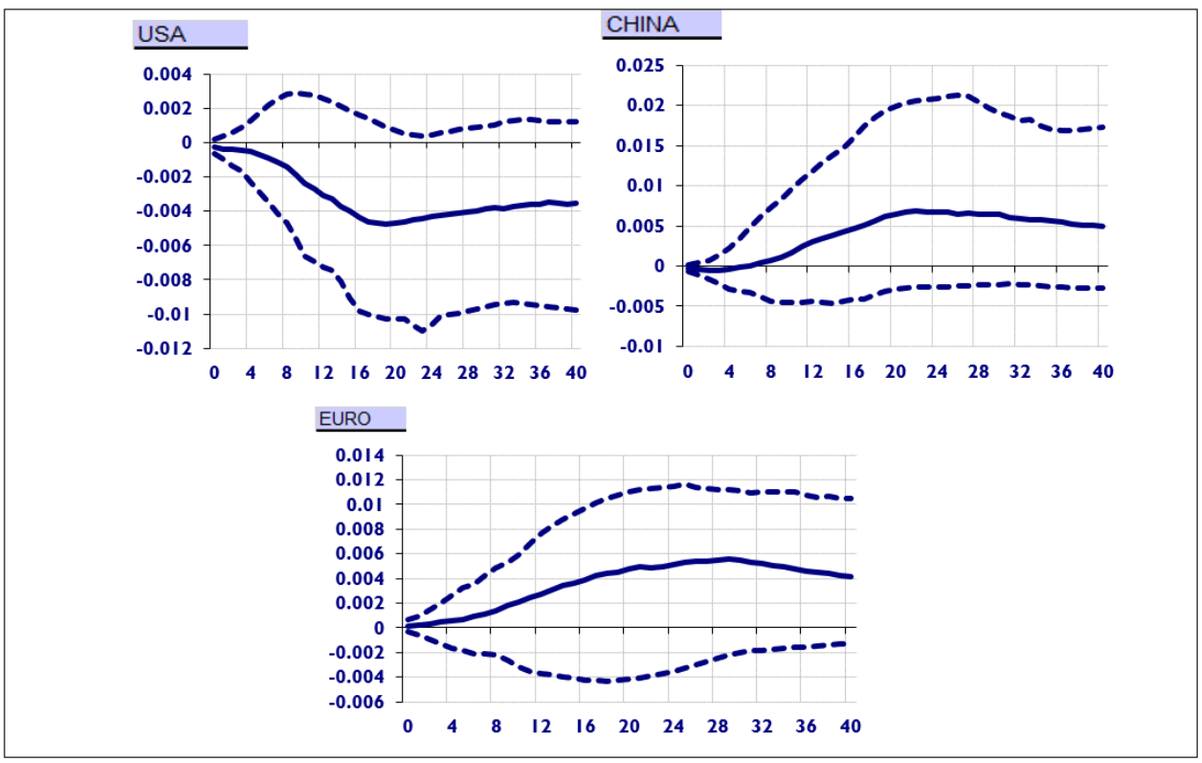

FIGURE 1: Nigerian Output Responses to Negative output shock in USA, China and Euro Zone.

WEAK EXOGENEITY AND CO-INTEGRATION TESTS

As stated earlier, the assumption of weak exogeneity is an important assumption in the GVAR procedures. This assumption is compatible to a reasonable extent with a degree of weak dependence across u_{it} as pointed out in Pesaran, Shuermann and Weiner (2004). In line with Johansen (1992) and Granger and Lin (1995), weak exogeneity assumption of co-integrating implies no long-run feedback from domestic variables to foreign variables without jettisoning lagged short-run feedback between the two variables. In an effort to determine the validity of this assumption for endogenous variables for Nigeria and other strategic countries selected based on trade relations, we employed Schwarz information criterion (SC) to choose the optimal lag length. The results showed optimal lag length of 1 for both domestic and foreign variables for Nigeria. In a similar vein, the results showed the same optimal lag length of 1 for China, United State (US) and Euro. For all the selected countries, the assumption of weak exogeneity of foreign variables is accepted for all VARX models.

Following the Johansen (1988) eigenvalue and trace statistics approach, the results of the co-integration test for selected countries are presented in table 2. The results indicate four co-integrating the relationship for both Nigeria and China, six co-integrating relationship for both US and Euro with both the trace statistics and maximal Eigen statistics greater than the critical values at 5% significance level. Based on these results, it is safe to conclude that there exists a long-run relationship between domestic variables and their foreign counterparts in all the selected countries.

In an attempt to investigate the effect of COVID-19 on the macroeconomic variables of a small open economy like Nigeria, negative shocks to output in China, the United State and Euro were simulated. The countries and region were selected based on trade relations with Nigeria and the extent of COVID-19 pandemic confirmed cases and deaths. In addition, negative shocks to oil price and global stock market were also simulated. The major benefit of GIRFs lies in its insensitivity to the ordering of the variables in the VARX unlike Sims (1980) that estimation results are

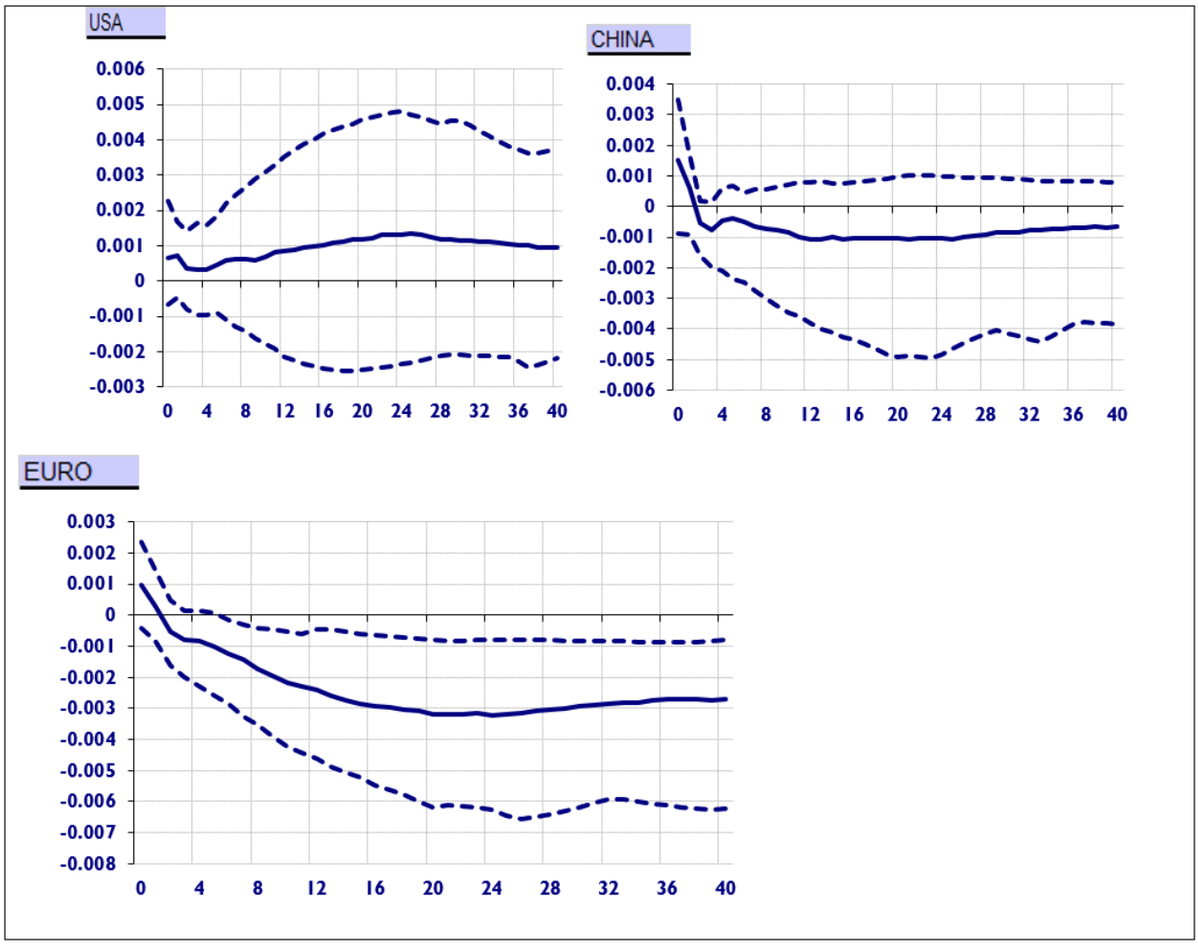

FIGURE 2: Nigerian Inflation Responses to Positive Inflation shock in USA, China and Euro Zone.

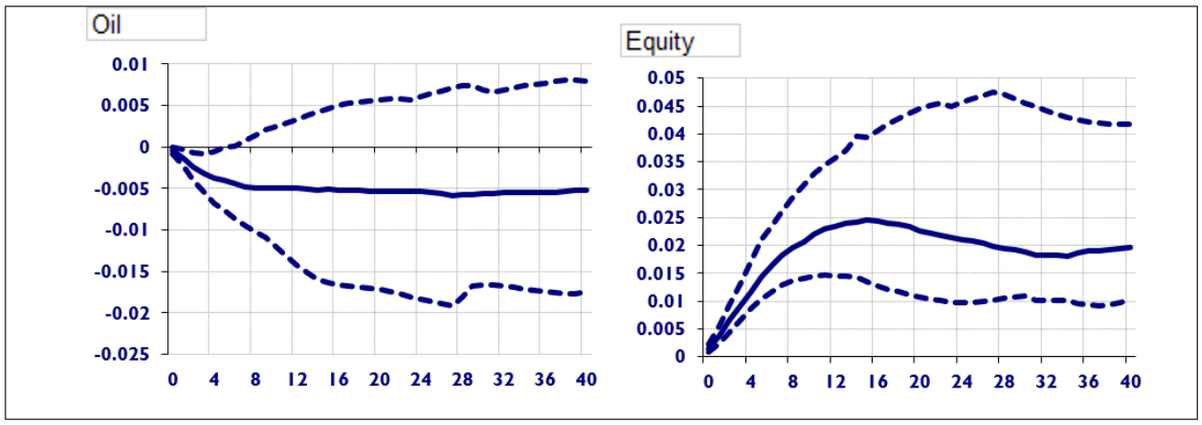

FIGURE 3: Nigerian Output Responses to Global Oil and Real Equity Prices

influenced by variables ordering. The results of all the simulations are presented in Figure 1, 2 and 3.

GENERALIZED IMPULSE RESPONSE

In Figure 1, the responses of Nigerian output to one standard negative shock to the US's real output is depicted in the first graph. The shock is equivalent to a fall of around 0.0047% in real output at the point of impact in the US and that also serves as the peak of the impact over the period. The transmission of the shock takes effect in Nigeria decreasing real output in the country by 0.00018% at the beginning and peak at 0.0047%. The impact on Nigerian output seems to be persistent throughout the period. The projection of a 6.0% decline of output in the US by IMF as a result of COVID-19 pandemic can be transmitted into the Nigerian output by causing a decline of 0.22% and this is expected to increase moderately for some period before starting to dissipate. However, just as the model predicts, the impact is expected to be persistent throughout the period.

Similarly, the second graph shows Nigerian output response to one standard negative shock to China's real output. The shock causes 0.0094% output decline in China and peak within the first quarter at 0.011%. The shock is transmitted into the Nigerian economy with an immediate impact of 0.00025% decline in output. The impact is a bit higher than what obtains in the case of US however, the impact dissipates completely within the first quarter after reaching the peak of 0.0037%. On other the side, while Nigerian output shrinks as a result of negative shocks to US's and China's outputs, against expectation it shows a positive response to shock in the Euro area. One standard negative shock to output in Euro with an immediate impact of 0.0029% decline in the economy transmits a positive shock to Nigerian output. The output increases by 0.00014% and attains the peak of 0.0008% before dissipating however, the impact remains persistent throughout the period.

In Figure 2, the impulse response function of Nigerian responses to positive inflation shocks in the USA, China and Euro were simulated in the form of one standard positive shock. The simulation of positive shock in these countries was informed by the expected supply-side constraints as results of COVID-19 pandemic. The results as presented show that Nigerian inflation shows a positive response to inflation shock from the USA. This suggests that inflationary pressure in the country can be transmitted into the Nigerian economy. In addition, the impact remains persistent throughout the period. This points to the vulnerability of inflation in Nigeria to expected inflationary pressure due to supply-side constraints as results of COVID-19 pandemic in global epicentre like the USA. In the second and the third graph in Figure 2, the impulse response results depict the responses of inflation in Nigeria to positive inflation shocks in China and the Euro. In line with the expectation, the inflation in Nigeria shows positive responses to inflation shocks from these two regions. This adds to the expected inflationary pressure in Nigeria however, the pressure from these two regions subsides within the first quarter and this makes them less of a threat to Nigerian inflation.

In Figure 3, the two graphs show the responses of output to global oil price and real equity price. In line with the expectation, Nigerian output shrinks in reaction to one standard negative shock to the global oil price. At the point of impact, the Nigerian output shrinks by 0.00048% and declines further in the second quarter to attain the peak of 0.0051%. This can be categorized as the biggest external shock to the Nigerian economy. However, just like other output shocks in the US and Euro, the impact remains persistent. One standard negative shock to global oil price is equivalent of 0.1% decline in oil price and this translates to 00048% decline in Nigerian output and declines steadily further to attain the peak of 0.005% in the second quarter. The current price of $20 per barrel of global price can be better imagined on the Nigerian economy. In Figure

2, the second graph shows the response of Nigerian output to one standard negative shock to global real equity price. Contrary to our expectation, the response appears positive and persistent and this suggests that the Nigerian stock market might not be properly integrated with the global stock market.

CONCLUSIONS

The study was able to examine the level of vulnerability of macroeconomics variables in Nigeria to shocks arising from COVID-19 pandemic in major countries and regions of the world and the study revealed the following. Apart from the direct impact of COVID-19 on the Nigerian economy, in addition, the country is susceptible to output shocks in the USA and to some extent China. The expected negative shocks from these countries will contribute substantially to output decline in Nigeria thus pushing the economy towards negative growth rate as predicted by the IMF. However, output shock from the Euro area is less of a threat to the Nigerian economy. These findings align with Oyelami and Olomola (2016) and Olayungbo (2019) and on the vulnerability of the Nigerian economy to an array of external shocks.

The study also established the expected increase in inflation due to supply-side shocks in the USA and to some extent, China can exacerbate the inflationary pressure in the country by jointly contributing 0.0017% to the variables in the first quarter. Furthermore, as expected negative shock to oil price constitutes an important threat to Nigerian output, however, this study established that the threat from this source represents the biggest threat to the Nigerian economy. The major limitation of this study was in the inability to get equity price and long-term interest data for Nigeria. This may have limited the influence of global equity price on the Nigerian stock market and by extension the Nigerian economy.

The key recommendation arising from this study borders on the issue of diversification. The country needs to diversify its economy both in terms of products and trade partners. More importantly, the appropriate fiscal and monetary stimulus package should be designed and implemented to motivate the sectors that are externally dependent and small and medium scale businesses that constitute the larger part of the economy. This will help a great deal to move the economy out of impending recession if not depression.

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