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INTERACTIVE EFFECT OF EXCHANGE RATES WITH REMITTANCE ON INFORMAL REMITTANCE CHANNEL: A DYNAMIC ANALYSIS

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ABSTRACT

Purpose- It has been commonly observed that remittance flows to low- and middle-income countries surpassed overseas development assistance. It is also often noted that the sums remitted through formal channels represent only a fraction of total remittances: a large though unknown amount of funds finds its way to families in migrants' areas of origin through informal channels. In Nigeria for instance, there is high prevalence of informality and the country currently has multiple exchange rates and adopts the managed floating exchange rate system. The objective of this paper is to examine whether multiple exchange rate has been an incentive for the popularity of unsafe informal channels in the remittance ecosystem of Nigeria. In order to achieve the objective, this study examines the interactive effect of exchange rate with remittance on informal remittance channels in Nigeria.

Methodology- Annual time series data were employed for the study. The data spanned the period 2004 to 2020 and were sourced from Index Mundi.com and the Global Economy.com. Autoregressive distributed lag (ARDL) model was used to analyze the data.

Findings- The interactive term i.e., LOGOEXC*LOGREMR (official exchange rate * personal remittances received) has positive and significant influence on informal remittance channel only in the short run.

Conclusion- Exchange rate has been an incentive for the popularity of unsafe informal channels in the remittance system of Nigeria. The implication is that government must carry out exchange rate reforms, including a unified market-clearing rate that reduces the gap between official and parallel market exchange rates which would enhance sending remittances through formal channels.

Keywords: Exchange rates, remittance, commercial banks, autoregressive distributed lag (ARDL), Nigeria.
JEL Codes: B26, C51 F31

1. INTRODUCTION

The informal economy is described as the sum total of economic activity that happens outside state regulation, which is neither taxed nor represented in a country's GDP. The size of the informal sector in Nigeria is estimated at about 65% of Nigeria's 2017 GDP and consists of activities that range from agricultural production to mining and quarrying, small-scale building and construction and machine-shop manufacturing (Maketaxfair.net, 2020). In some cases, the informal economy is referred to as a shadow economy if associated with illegality and illicit activities such as internet scams, black markets, crime, production, and smuggling of illegal drugs, and money laundering or as the case may be. In this case study, the focus is on informal remittance and it is essential to state the exact definition to be used in the study of this informality. Remittances are financial transfers by migrants to their country of origin (Van Hear et al., 2005). Official remittance channels of transfer include bank services, money transfer operator (MTO) services, etc. Informal remittances are transfers that take place through informal channels. Unofficial remittance channels of transfer include carrying cash when travelling back home, relying on trader relationships or value transfer systems to offset import payments with remittances (Cooper and Esser, 2018).

According to Agusto and Co (2022), Nigeria has over $21 billion annually in inflows from diaspora remittances, making it the second-largest recipient of remittances on the continent, only after Egypt. The remittances from the Nigerian diaspora have

become a major mainstay of the country's economy. At the macro level, diaspora remittances represent the second-largest source of foreign exchange inflow into the country, second only to crude oil earnings. Interestingly, the country's yearly remittance is conservatively valued at $34 billion (Iyatse, 2021). But the country rarely comes close to realizing this figure, going by historical data. But that is less a concern than the consistent reduction in the amount received via the official window in the past few years.

Nevertheless, the stability of the exchange rate is a major macroeconomic indicator used to measure the performance of an economy. Nigeria's forex market has undergone significant changes over the years. The forex market has evolved from a fixed regime in the 1960s to a pegged arrangement between the 1970s and the mid-1980s, and to various types of managed floating systems since 1986 (the structural adjustment program period) (FDC, 2021). The crux of this paper therefore is to examine the interaction between official exchange rate and personal remittances received and its impact on informal remittance channels in Nigeria. As Iyatse (2021) observed, the official remittance market in Nigeria is in a battle for survival on all fronts. First, its old foe – the informal channels – is not relenting. And peer-to-peer (P2P) transfer is rearing its ugly head in readiness for what could be apocalyptic.

The remainder of this paper is structured as follows, section 2 is for literature review while section 3 gives an overview of remittance inflow and exchange rate management in Nigeria. Section 4 presents the data and methodology. Section 5 showcases the empirical findings, and finally section 6 concludes the paper.

2. LITERATURE REVIEW

Remittances have been growing rapidly in the past few years and now represent the largest source of foreign income for many developing countries. However, it is hard to estimate the exact size of remittance flows because many transfers take place through unofficial channels. Worldwide, officially recorded international migrant remittances were projected to exceed $483 billion in 2011, with $351 billion flowing to developing countries (Ratha, 2020). These flows are recorded in the balance of payments; exactly how to record them is being reviewed by an international technical group. Unrecorded flows through informal channels are believed to be at least 50 percent larger than recorded flows (Ratha, 2020). Not only are remittances large but they are also more evenly distributed among developing countries than capital flows, including foreign direct investment, most of which goes to a few big emerging markets. In fact, remittances are especially important for low-income countries. Remittance flows to low-income countries are nearly 6 percent of their gross domestic product (GDP), compared with about 2 percent of GDP for middle-income countries (Ratha, 2020).

Furthermore, data from the World Bank showed that global remittances grew by 10 percent to $689 billion in 2018 from $633 billion in 2017 with developing countries receiving 77 percent or $528 billion of the total inflows (Komolafe, 2020). The World Bank also showed that remittances to developing countries rose further by 4.9 percent to $554 billion in 2019. In Sub-Saharan Africa, which include Nigeria and 47 countries, remittances rose by 4.3 percent to $48 billion in 2019 from $46 billion in 2018 (Komolafe, 2020). World Bank data also shows a rising trend in diaspora remittances into Nigeria. From $20.8 billion in 2014, remittances into Nigeria rose to $25.1 billion in 2018, translating into 4.3 percent growth (Komolafe, 2020). Highlighting the impact of remittances on Nigeria's economy, Pricewaterhouse Coopers (PwC) noted that the $25.1 billion remittances inflow in 2018 translates to 83 percent of the Federal Government budget in 2018 and 11 times the Foreign Direct Investment (FDI) flows in the same period (Komolafe, 2020). Nigeria's remittance inflows were also seven times larger than the net official development assistance (foreign aid) of $3.4 billion received in 2017(Komolafe, 2020).

However, the World Bank noted that the remittances reported represent official records, and are lower than figures of total inflow through formal and informal channels. A study by the bank indicated that remittances through informal channels could add at least 50 percent to the globally recorded flows. For Nigeria this translates to about $7.5 billion additional remittances based on the figure for 2018 (Komolafe, 2020).

This represents a huge foreign exchange leakage and portends serious implications for the economy, especially at a time of declining foreign exchange earnings from crude oil, which accounts for over 80 percent of the nation's foreign exchange earnings (Komolafe, 2020).

The focus of this study is on Nigeria because its migrants are often well educated and highly skilled. For instance, in the USA, they are the immigrant group with the highest level of education in the country (Chron, 2018). This profile allows the diaspora to send larger amounts of money back home compared to other Sub-Saharan African countries due to higher average earnings.

Nevertheless, studies have been carried concerning remittances in Nigeria (Odozia et al., 2010; Nwosu, 2012; Iheke, 2012; Akinpelu et al., 2013; Akano et al., 2013; Adeagbo and Ayansola, 2014; Fayomi et al., 2015; Adeyi, 2015; Loto and Alao, 2016;

Ebenezer, 2015; Egbulonu and Chukuezi, 2019; Anetor, 2019; Adeseye, 2021). In addition, Oke and Adetan (2018); Williams et al. (2018), Odili (2015), Ajibola et al (2015), Dickson and Ukavwe (2013), Ngerebo and Ibe (2013), Oriavwote and Oyovwi (2012), Nwude (2012), Aliyu (2011), Joseph (2011), Osinubi and Amaghionyeodiwe (2009), Ogunleye (2008), and Udoh and Egwaikhide (2008) have researched on exchange rate in Nigeria, but no study has been conducted on the effect of official exchange rate on the preference for unofficial remittance channels. Nevertheless, Nigeria operates a dual exchange rate. Scott (2021) defines a dual exchange rate as a setup created by a government where their currency has a fixed official exchange rate and a separate floating rate applied to specified goods, sectors or trading conditions.

In 2016, the Nigerian economy entered a recession. The CBN introduced the dual exchange rate system in 2017 after the nosedive of the Naira, hitting as low as N600 to the dollar, after the depletion of the country's oil revenue following the slump of global oil prices from $57 to $37 per barrel, thus putting pressure on the nation's foreign exchange reserve (Eletu, 2021). Oil revenue represents 90% of Nigeria's foreign exchange earnings and accounts for more than half of the governments' total revenue (Eletu, 2021). The multiple exchange rate system set by the CBN consists of parallel rates and official rates. The official rate (available to investors and importers and exporters only) harbors a much lower rate compared to the parallel rate, which is easily accessible to the country's residents. Specifically, this study attempts to examine the effect of an independent variable on a dependent variable changes, depending on the values of one or more other independent variables. As such, it investigates the dynamic interaction between official exchange rate and personal remittances received (two-way interaction) and its impact on informal remittance channels using autoregressive distributed lag (ARDL) models in a single-equation framework.

3. REMITTANCE INFLOW AND EXCHANGE RATES MANAGEMENT IN NIGERIA: OVERVIEW

Diaspora remittances into Nigeria increased by 15.6% QoQ to $9.22 billion in H1 2021 compared to $7.98 billion recorded in the second half of 2020. It also represents a marginal 2.2% increase compared to $9.02 billion recorded in the corresponding period of 2020. This is according to the review of Nigeria's balance of payment account as released by the Central Bank of Nigeria (CBN) (Oyekanmi, 2021). The increase is as a result of measures introduced by CBN to encourage diaspora Nigerians to send their remittances through the banking system. Among other things, the measures allow beneficiaries to have unfettered access and utilization to foreign currency proceeds, either in foreign exchange cash and/or in their Domiciliary Accounts. Furthermore, the CBN directed payment switching and processing companies to stop local currency transfer of diaspora remittances received through International Money Transfer Operators (IMTOs). The apex bank also directed Mobile Money Operators (MMO) to disable wallets from receipt of funds from IMTOs. To complement these measures, the CBN in February 2021 introduced the "Naira4Dollar" scheme, which rewards beneficiaries of remittances with N5 for every $1 of remittance sent through the banks (Komolafe, 2022).

The World Bank report also indicated that Nigeria was the largest recipient of remittance inflows in the Sub-Saharan region of Africa in 2021. Meanwhile, remittance inflows to Sub-Saharan Africa grew by 6.2% to $45 billion in 2021, and is projected to grow by 5.5% in 2022. According to the World Bank, remittances to low-and middle-income countries were projected to have grown by 7.3% to reach $589 billion in 2021 (Oyekanmi, 2021).

Nevertheless, Nigeria's forex market has undergone significant changes over the years. The forex market has evolved from a fixed regime in the 1960s to a pegged arrangement between the 1970s and the mid-1980s, and to various types of managed floating systems since 1986 (the structural adjustment program period).

The country currently has multiple exchange rates (parallel, bureau de change, International Air Transport Association (IATA), investors and exporters window, but to name a few) and currently adopts the managed floating exchange rate system. On May 24 2021, the CBN officially replaced the official exchange rate with the more flexible Nigerian Autonomous Foreign Exchange Fixing Rate (NAFEX) rate in an attempt to unify the country's multiple exchange rates. This replacement means a technical devaluation of the naira by 7.56% to the NAFEX rate (N410/$) from the previous official rate of N379/$ (Proshareng.com, 2021). However, the exchange rate has remained volatile at the parallel market, driven by speculative activities and panic buying.

4. DATA AND METHODOLOGY

4.1. Data

The data for the variables were collected from Index Mundi.com and the Global Economy.com., and the time span selected from 2004 to 2020 due to the availability of data. The variables include:

ICHAN = informal remittance channel or informal transfers (proxy by informal sector as percent of total annual GDP).

COMB= Commercial bank branches (per 100,000 adults) are retail locations of resident commercial banks and other resident banks that function as commercial banks that provide financial services to customers and are physically separated from the main office but not organized as legally separated subsidiaries.

OEXC= Official exchange rate (LCU per US$, period average) refers to the exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market.

REMR = Personal remittances, received (current US$) in Nigeria consist of all current transfers in cash or in kind made or received by resident households to or from nonresident households.

OEXC*REMR = Interactive term, i.e., the product of personal remittances received and official exchange rate.

FINF= Financial freedom index evaluates: the extent of government regulation of financial services, the degree of state intervention in banks and other financial firms through direct and indirect ownership, the extent of financial and capital market development, government influence on the allocation of credit and openness to foreign competition. Higher index values denote banking efficiency and independence from government control and interference in the financial sector.

MFRI= Monetary Freedom index for Nigeria from the Heritage Foundation reflects the stability of prices in Nigeria and the use of price controls by the government. Price stability with minimal price controls is the ideal state for the free market. The score for the monetary freedom index is based on two factors: the weighted average inflation rate for the most recent three years and price controls. Higher index values denote price stability without microeconomic intervention.

4.2. Empirical Model Specification

To investigate the interactive effect of official exchange rate with remittances on informal remittance channels, the following is specified:

Informal Remittance Channel = ƒ (Commercial Bank Branches, Official Exchange Rate, Personal Remittances Received, Financial Freedom Index, Monetary Freedom Index) (1)

Or

ICHAN = ƒ (COMB, OEXC, REMR, MFRI, FINF) (2)

The above equation can be written in econometric and natural log form as:

$$\ln ICHAN_t = \boldsymbol{\eta}_0 + \boldsymbol{\eta}_1 \ln COMB_t + \boldsymbol{\eta}_2 \ln OEXC_t + \boldsymbol{\eta}_3 \ln REMR_t + \boldsymbol{\eta}_4 \ln(OEXC * REMR)_t + \boldsymbol{\eta}_5 \ln MFRI_t + \boldsymbol{\eta}_6 \ln FINF_t + \boldsymbol{\Phi}_t \quad (3)$$

where the subscript t denotes the studied time period, In is the logarithmic form of the variable and $\boldsymbol{\Phi}$ denotes the error-term. The parameters $\boldsymbol{\eta}_0$ and $\boldsymbol{\eta}_i$ (1,2,3,4,5, and 6) are the intercept and the coefficients to be calculated. Apriori, $\boldsymbol{\eta}_2 > 0$, $\boldsymbol{\eta}_4 > 0$; $\boldsymbol{\eta}_1 < 0$, $\boldsymbol{\eta}_3 < 0$, $\boldsymbol{\eta}_5 < 0$, $\boldsymbol{\eta}_6 < 0$

4.3. Technique of Analysis

The dependent variable is dynamic in nature and have persistence nature where present size of shadow economy has to some extend dependency on pass size. Therefore, instead of static models i.e. OLS, equation (1) is estimated using Autoregressive distributed lag (ARDL) model which is often used to analyze dynamic relationships with time series data in a single-equation framework. The current value of the dependent variable is allowed to depend on its own past realizations – the autoregressive part – as well as current and past values of additional explanatory variables – the distributed lag part. In its basic form, an ARDL regression model is as follows:

$$y_t = \beta_0 + \beta_1 y_{t-1} + ...+ \beta_p y_{t-p} + \alpha_0 x_t + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + ... + \alpha_q x_{t-q} + \varepsilon_t \quad (4)$$

where ε_t is a random "disturbance" term.

The model is "autoregressive", in the sense that y_t is "explained (in part) by lagged values of itself. It also has a "distributed lag" component, in the form of successive lags of the "x" explanatory variable. Sometimes, the current value of x_t itself is excluded from the distributed lag part of the model's structure.

Since the data used in this study are time series, there is need to check the stationarity of the data before applying ARDL model. This is because unit roots can cause unpredictable results in time series analysis. However, the application of ARDL is possible even when the variables under consideration are integrated on different order (I(0), I(1) or mixture of both (Pesaran et al., 2001).

As such, the stationarity properties of our data was checked using the Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1979) and the Phillips Perron (PP) test (Phillips and Perron, 1988). The PP unit root test is similar to the ADF test; the primary difference is in how the tests each manage serial correlation. Where the PP test ignores any serial correlation, the ADF uses a parametric autoregression to approximate the structure of errors. Oddly enough, both tests typically end with the same conclusions, despite their differences (Moffatt, 2019). The general form of these tests is estimated in the following forms:

$$\Delta Y_t = b_0 + \beta Y_{t-1} + \mu_1 \Delta Y_{t-1} + \mu_2 \Delta Y_{t-2} + \ldots + \mu_p \Delta Y_{t-p} + e_t \quad (5)$$

Where, Y_t represents time series to be tested, b_0 is the intercept term, β is the coefficient of interest in the unit root test, μ is the parameter of the augmented lagged first difference of Y_t to represent the p^{th} order autoregressive process and e_t is the white noise error term.

5. EMPIRICAL FINDINGS

5.1. Preliminary Test

The correlation coefficient in Table 1 revealed the existence of a linear relationship between the regressand and the regressors. From the result, the coefficient of correlation of the dependent variable (LOGICHAN) with respect to itself was (1.00) which revealed perfect correlation. There was a positive correlation between informal remittances (LOGICHAN) and LOGOEXC and LOGFINF with coefficients of 0.654 and 0.003 respectively. LOGICHAN and LOGOEXC were strongly positively correlated. Interestingly, the values for LOGICHAN vs LOGFINF indicated that they are basically not correlated. On the other hand, LOGCOMB, LOGREMR, and LOGMFRI all had negative correlation with informal remittance (LOGICHAN). Their respective coefficients were -0.530, -0.028, and -0.509. LOGICHAN and LOGREMR indicates very weakly negatively correlation while LOGICHAN vs LOGCOMB, LOGICHAN vs LOGMFRI showed moderately strong negative correlation. However, the entire values in the correlation matrix revealed a moderately weak relationship and indicates the absence of multicollinearity among the variables in the model.

Table 1: Correlation Matrix

	LOGICHAN	LOGCOMB	LOGOEXC	LOGREMR	LOGMFRI	LOGFINF
LOGICHAN	1					
LOGCOMB	-0.530	1				
LOGOEXC	0.654	-0.438	1			
LOGREMR	-0.028	0.117	0.382	1		
LOGMFRI	-0.509	0.731	-0.564	-0.069	1	
LOGFINF	0.003	0.463	0.257	0.580	0.135	1

Source: Author's computation using Eviews 10 software

The descriptive statistics of the key variables in equation 1 are shown in Table 2. It depicts that the Jarque–Bera test for most of the variables used in the study are insignificant, which implies that most of them are normally distributed. The skewness measures the degree of lopsidedness in the frequency distribution. Conversely, kurtosis measures the degree of tailedness in the frequency distribution. In Table 2, the Kurtosis shows that some of the distributions of series are flat peak (platykurtic) relative to the normal (normal distribution is 3) while some are sharply peaked (leptokurtic). Half of the variables showed negative skewness while the other half showed positive skewness. The standard deviation shows that there is some dispersion in all the variables while the mean shows the average values of the variables from 2004 to 2020.

Table 2: Descriptive Statistics

	LOGCOMB	LOGOEXC	LOGREMR	LOGICHAN	LOGMFRI	LOGFINF
Mean	1.630335	5.185793	23.59474	4.003547	4.252995	3.651238
Median	1.605430	5.058218	23.74578	3.971423	4.254193	3.688879
Maximum	1.880991	5.723847	23.91420	4.176078	4.347694	3.912023
Minimum	1.329724	4.775335	21.54425	3.924742	4.122284	3.401197
Std. Dev.	0.177473	0.353453	0.543037	0.073126	0.054114	0.130860
Skewness	0.044445	0.643410	-3.425296	1.014120	-0.538468	-0.818456
Kurtosis	1.661833	1.805782	13.52336	2.960906	3.603468	3.708809
Jarque-Bera	1.274002	2.183127	111.6841	2.914991	1.079476	2.253842

Probability	0.528876	0.335691	0.000000	0.232819	0.582901	0.324029
Sum	27.71570	88.15847	401.1106	68.06030	72.30092	62.07105
Sum Sq. Dev.	0.503945	1.998865	4.718224	0.085558	0.046853	0.273989
Observations	17	17	17	17	17	17

Source: Author's computation using Eviews 10 software

The stationary test on the time series properties of the data were examined by conducting the unit root test using the Augmented Dickey-Fuller (ADF) test and Philips-Perron test. The ADF was conducted with a maximum lag of 3 and Schwarzt information criterion. Philips-Perron test was conducted with default (Bartlett kernel) spectral estimation method as well as with Newey-West Bandwith automatic selection. The both test statistics were done for two alternative specifications. First, it was tested with intercept, and then it was tested without intercept. The result of ADF (Table 3) and PP (Table 4) unit root tests reflect that there is no unit root in the series. Both tables suggest that the variables are either stationary at order I(0) or at order I(1). Based on the outcome, the autoregressive distributed lag (ARDL) model was considered as the best econometric method to apply compared to others in a case when the variables are stationary at I(0) or integrated of order I(1).

Table 3: Augmented Dickey-Fuller (ADF) Unit Root Test Result

Variables	With intercept		Without intercept		Order of Integration
	Levels	1st diff	Levels	1st diff	
LOGCOMB	-2.091125	-2.704373***	-0.046764	-2.813005*	*I(1)*
LOGFINF	-3.132900**	-5.452590*	-1.544685		*I(0)*
LOGICHAN	-1.347422	-4.363234*	-2.013440**	-3.796649*	*I(0)*
LOGMFRI	-0.496957	-3.902587**	-0.817126	-3.924957*	I(1)
LOGOXEC	0.182274	-2.605025	2.010643	-2.232693**	I(1)
LOGREMR	-21.01812*	-4.423228*	1.175082	-29.73830*	I(0)

Note: Significance level at 1%, 5% and 10 % as *, ** and *** respectively

Table 4: Phillips-Peron Unit Root Test Result

Variables	With intercept		Without intercept		Order of Integration
	Levels	1st diff	Levels	1st diff	
LOGCOMB	-1.343420	-2.704373***	-0.289956	-2.813005*	*I(1)*
LOGFINF	-4.414099*	-5.856631*	0.874859	-5.811897*	*I(0)*
LOGICHAN	-1.267358	-4.363234*	-2.015783**	-3.790754*	*I(0)*
LOGMFRI	-0.496957	-3.902587**	-0.817126	-3.924957*	I(1)
LOGOXEC	0.182274	-2.622455	2.010643	-2.232693**	I(1)
LOGREMR	-15.65655*	-82.37909*	1.175082	-32.50025*	I(0)

Note: Significance level at 1%, 5% and 10 % as *, ** and *** respectively

5.2. Lag Selection Criteria

Before applying the ARDL bound test for checking if cointegration exists or not among the variables, it is wise to select an appropriate lag order of the variable. The optimal lag order of the vector autoregression (VAR) model for the selection of appropriate lag order was deployed. The observed results in Table 5 show the entire lag selection criteria for employing the ARDL bound test which implies that the model gives better results at lag 1.

Table 5: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	102.1305	NA	2.44e-13	-12.01631	-11.72659	-12.00148
1	213.0790	124.8170*	3.04e-17*	-21.38487*	-19.35682*	-21.28102*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

5.3. Bounds Test

Since it was established that none of the selected series are I(2) or beyond and the optimal order of lag has been determined, presence of the long run cointegration was tested using bounds test. The results of the ARDL bound test of cointegration are displayed in Table 6. The F-statistics has a higher value (6.816019) than the upper bound critical value, provided by Pesaran et.al (2001), is 5.23 (at 1% significance level) hence there is a strong reason to reject the null hypothesis of no long-run relationship at 1% significance level. Invariably, there is the existence of cointegration among the variables studied.

Table 6: F-Bounds Test Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	6.816019	10%	2.75	3.79
K	6	5%	3.12	4.25
		2.5%	3.49	4.67
		1%	3.93	5.23

5.4. ARDL Model

A 'general-to-specific' methodology was applied when estimating the ARDL model, with the original model estimated with one lag for each variable and a constant. The over-parameterized ARDL model is presented in column 1 (ARDL 1) of Table 7 and a more parsimonious model was obtained by deleting insignificant variables. The results of the parsimonious ARDL model are reported in column 2 (ARDL 2) of Table 7. It shows the coefficients of current and lagged values of each explanatory variable as well as the coefficients of lagged value of the dependent variable. Diagnostic tests were conducted to examine the health conditions of the parsimonious long-run ARDL model (ARDL 2). The probability value of the Jarque-Bera statistics (0.405308) is greater than 5% level of significance, hence the null hypothesis of normality is accepted, and therefore the residual of the model is normally distributed. The model passed the Ramsey RESET specification test with the probability value of F-statistic (0.2252) greater than 0.05 indicating that the null hypothesis is not to be rejected at 0.05 levels implying no functional misspecification in the model. However, the Breusch-Godfrey serial correlation LM test clearly shows that the probability Chi-Square (0.0621) is less than 0.05 at 5% significance level which leads to the conclusion that the residual in the long-run ADRL model is serially correlated. In terms of the Likelihood ratio test for redundant variables, Ho: variables are redundant; H1: null hypothesis is not true. Decision criteria: reject null hypothesis if the value of the adjusted R2 from the parsimonious model is lower than that from the over-parameterised model. The result in Table 7 shows that the value of the adjusted R2 from the parsimonious model (ARDL 2) is slightly lower than that from the over-parameterised model (ARDL 1). As such, null hypothesis is rejected. That means, the variables are in the model are not redundant. As a matter of fact, the result of parsimonious long-run ARDL model (ARDL 2) in Table 7 shows that informal remittance channel in the prior period LOGICHAN (-1), commercial bank branches in the current period [LOGCOMB], commercial bank branches in the prior period [LOGCOMB (-1)], official exchange rate in the current period [LOGOEXC], and personal remittances received in the current period [LOGREMR] significantly influence informal remittance channel in the long run. Specifically, ARDL 2 result suggests that informal remittance channel in the prior period LOGICHAN (-1) is negatively related to the informal remittance channel in the current period. Evidence indicates that a percentage increase informal remittance channel in the prior period shrinks informal remittance channel in the current period by about -1.173297. The coefficient is statistically significant at 1% significance level. Moreso, commercial bank branches in the current period [LOGCOMB] has a positive and significant effect on informal remittance channel in the long-run. A one per cent increase in commercial bank branches in the current period enhances informal remittance channel by 0.577561%. With around 8,000 commercial bank branches – most of them in big cities – in a country of 200 million people, formal banking services remain out of the reach of most Nigerians (Ajifowoke, 2021). A quarter of respondents in a 2018 survey by Enhancing Financial Innovation and Access (EFInA) cited distance

as one of the factors discouraging them from patronising formal banking institutions (Ajifowoke, 2021). This could compel formal remittance senders and recipient to search for informal remittance channels as portrayed by the result of this study. Surprisingly, commercial bank branches in the prior period [LOGCOMB (-1)] has a negative and significant effect on informal remittance channel in the long-run. Statistically, this result is significant at 10% significance level. Evidence provided indicates that an increase in commercial bank branches in the prior period decreases informal remittance channel in the long-run by 0.266358%. As Ajifowoke (2021) observed, more Nigerians are now financially included compared to some years ago, however, thanks to the emergence of agency banking and mobile money models in the country. Both have been key to deepening access to financial services.

Furthermore, official exchange rate in the current period [LOGOEXC] has a significant negative long-run association with informal remittance channel at a 1% significance level while official exchange rate in the prior period [LOGOEXC (-1)] has a substantial insignificant positive long-run association with informal remittance channel. Moreso, in Table 7 (ARDL 2), estimated coefficients provide evidence that personal remittances received in the current period [LOGREMR] is negatively related to informal remittance channel in the long-run. Going by the specific coefficient, an increase in personal remittances received in the current period [LOGREMR] reduces informal remittance channel by 16.83817% in the long run. This result is statistically significant at 1% significance level. This result reflects Central Bank of Nigeria's constant strive to improve remittance infrastructure, ease the process of international money transfer and simplify the experience for senders and recipients. Recently, Central Bank of Nigeria explained that its new "Naira 4 Dollar Scheme" seeks to make remittance through formal bank channels cheaper and more convenient for Nigerians in the diaspora (Adegboyega, 2021). To account for the short-run relationships, an error correction model was estimated and the results are shown in ARDL 3 of Table 7, the error correction model [ECM (-1)] indicates the degree of adjustments in which the dependent variable adjusts to changes in the independent variables. The results show a well-defined error correction term [ECM (-1)] with an expected negative coefficient value of -1.242728 which indicates that about -12.43% of the previous periods disequilibrium in informal remittance channel (LOGICHAN) is corrected in the long-run. Surprisingly, the error correction model ECM (-1) was statistically insignificant at any of the standard conventional 1% or 5% or 10% significance levels. As such, insignificant variables were deleted and the coefficient of error correction term became negative and statistically significant at 10% significance level (see ARDL 4). The implication of a significant error correction term is that there is in fact a long-term relationship between the dependent variable and the independent variables in the model. An examination of the coefficients and statistical significance of the variables analyzed reveal a varying degree of relationships between the dependent and explanatory variables. In the short run (ARDL 4), commercial bank branches in the current period [LOGCOMB] has a positive and significant effect on informal remittance channel. Also, the interactive term i.e., LOGOEXC*LOGREMR (official exchange rate * personal remittances received) had positive and significant influence on informal remittance channel (LOGICHAN) while one period lag informal remittance channel [LOGICHAN(-1)], one period lag commercial bank branches [LOGCOMB(-1)], official exchange rate in the current period [LOGOEXC], and personal remittances received in the current period [LOGREMR] all have significant negative relationships with informal remittance channel (LOGICHAN) in the short run.

Specifically, a 1%-point increase in interactive term, i.e., LOGOEXC*LOGREMR (official exchange rate * personal remittances received) increases informal remittance channel (LOGICHAN) by 3.001878%. In addition, an increase in one period lag informal remittance channel [LOGICHAN (-1)] by 1% causes informal remittance channel (LOGICHAN) to decline by 1.171541% over the short-run period at the 1% significance level. Similarly, one-unit increase in first period lag of commercial bank branches [LOGCOMB (-1)] will lead to 0.218094 fall in informal remittance channel (LOGICHAN).

Furthermore, the result shows that official exchange rate in the current period [LOGOEXC] has

coefficient of -71.05951which is significant at 1% indicating that a unit increase in official exchange rate in the current period [LOGOEXC] will lead to 71.05951unit decrease in informal remittance channel (LOGICHAN) in the short run.

A closer examination reveals that the coefficient of personal remittances received in the current period [LOGREMR] is -0.318859 and it is statistically significant at 1% significance level. This implies a negative and significant relationship exist between personal remittances received in the current period and informal remittance channel in Nigeria. This implies that a percentage increase in personal remittances received in the current period all things being equal will result in 0.318859 per cent decrease in informal remittance channel in Nigeria in the short run.

Nevertheless, a few diagnostic tests were deployed to examine the errors in the model. The adjusted coefficients of determination (adjusted R-square) value of 0.975200 reveals that about 97.5% of the systematic variations in the dependent variable (LOGICHAN) is jointly explained by the independent variables all taken together. Invariably, the model is a good fit. The Ramsey reset test illustrates that the functional form of the estimated model is correct. Similarly, Breusch-Pagan-Godfrey heteroscedasticity test shows that there is no heteroscedasticity problem in the model. But the Breusch-Godfrey Serial Correlation LM Test shows that

the residual in the short-run ADRL model is serially correlated. However, the estimated scores of the Jarque–Bera test result implies that the existing model is normal distributed. This study also performed the cumulative sum (CUSUM) of recursive residuals and cumulative sum of square (CUSUMSQ) of recursive residuals stability tests. Fig. 1 shows the CUSUM and Figure 2 shows the CUSUMSQ plots. Both figures depict that the CUSUM and CUSUMSQ statistics are well within the critical bounds, implying that the model is stable over the period analyzed.

Table 7: Autoregressive Distributed Lag (ARDL) Model Result

Long Run			Short Run		
Variable	**ARDL 1**	**ARDL 2**	**Variable**	**ARDL3**	**ARDL4**
LOGICHAN(-1)	-1.198796*	-1.173297*	D(LOGICHAN(-1))	-1.181186*	-1.171541*
LOGCOMB	0.399278***	0.577561**	D(LOGCOMB)	0.575584**	0.529669*
LOGCOMB(-1)	-0.111073	-0.266358***	D(LOGCOMB(-1))	-0.248402	-0.218094**
LOGOEXC	-83.31764*	-76.46758*	D(LOGOEXC)	-69.63931**	-71.05951*
LOGOEXC(-1)	7.650065	6.663576	D(LOGOEXC(-1))	4.980966	5.340202
LOGREMR	-18.58653*	-16.83817*	D(LOGREMR)	-15.21186**	-15.58316*
LOGREMR(-1)	1.607971	1.397275	D(LOGREMR(-1))	1.038436	1.109390
LOGOEXC*LOGREMR	3.514884*	-0.276008	D(LOGOEXC*LOGREMR)	2.943944**	3.001878*
LOGOEXC (-1)*LOGREMR(-1)	-0.313824	-0.276008	D(LOGOEXC(-1)*LOGREMR(-1))	-0.205349	-0.218869
LOGMFRI	-0.069237	-0.037915	D(LOGMFRI)	-0.109551	
LOGFINF	-0.169028	-0.344380	D(LOGFINF)	-0.353686**	-0.318859
LOGFINF(-1)	0.111106		LOGFINF(-1)		
			ECM(-1)	-1.242728	-1.294891***
Diagnostic Test					
Adjusted R-squared	0.974322	0.963926		0.968913	0.975200
Durbin-Watson stat	2.057377	2.727808		1.974531	1.993544
Serial correlation	0.8644	0.0621		0.7737	0.0802
Heteroscedasticity	0.3614	0.6568		0.8515	0.3150
Normality	0.906147	0.405308		0.681617	0.724724
Ramsey RESET	0.6581	0.2252		0.4118	0.7552
CUSUM Stability Test					Model is stable
CUSUMSQ Stability Test					Model is stable

Significance level at 1%, 5% and 10 % as *, ** and *** respectively

Figure 1: Cumulative Sum (CUSUM) of Recursive Residuals

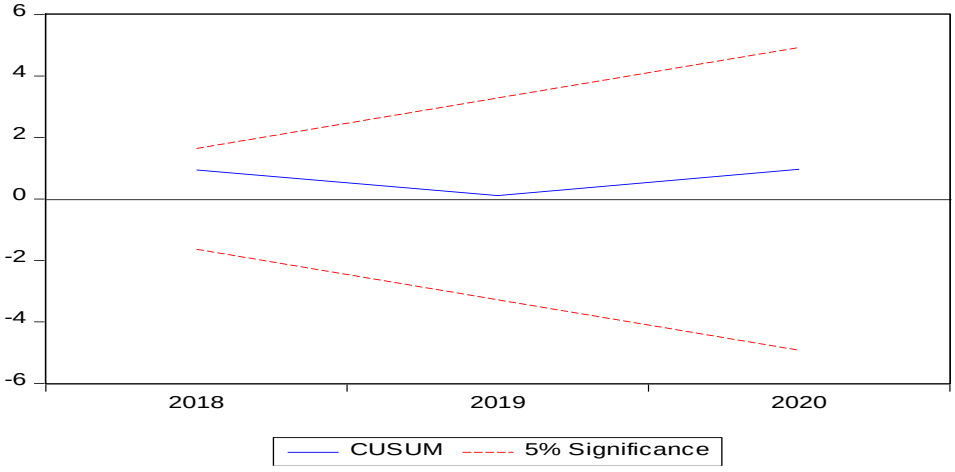
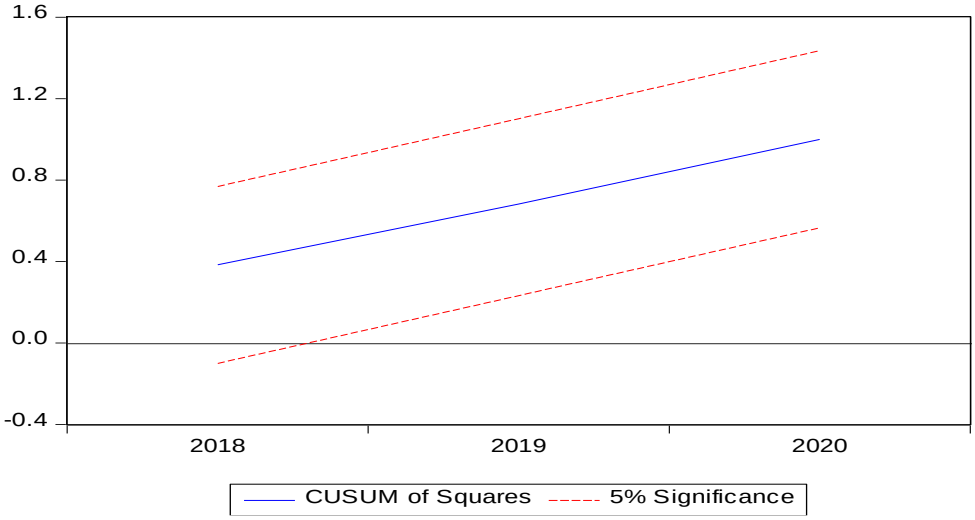


Figure 2: Cumulative Sum of Square (CUSUMSQ) of Recursive Residuals



5. CONCLUSION

International remittances have been recognized as an important driver of the economy of most developing countries. It plays vital roles in poverty reduction, income redistribution and economic growth, especially in rural areas. This study examines the interactive effect of exchange rate with remittance on informal remittance channels in Nigeria from 2004 to 2020. The study used secondary annual time series data obtained from Index Mundi.com and the Global Economy.com. The Autoregressive distributed lag (ARDL) model which is often used to analyze dynamic relationships with time series data in a single-equation framework was used for data analysis after achieving data stationarity through Augmented Dickey-Fuller (ADF) test and Philips-Perron test. The result of parsimonious long-run ARDL model reveals that informal remittance channel in the prior period LOGICHAN (-1), commercial bank branches in the current period [LOGCOMB], commercial bank branches in the prior period [LOGCOMB (-1)], official exchange rate in the current period [LOGOEXC], and personal remittances received in the current period [LOGREMR] significantly influence informal remittance channel in the long run. Only commercial bank branches in the current period [LOGCOMB] has a positive and significant effect on informal remittance channel in the long-run.

In the short run, commercial bank branches in the current period [LOGCOMB] has a positive and significant effect on informal remittance channel. Also, the interactive term i.e., LOGOEXC*LOGREMR (official exchange rate * personal remittances received) has positive and significant influence on informal remittance channel (LOGICHAN) while one period lag informal remittance channel [LOGICHAN(-1)], one period lag commercial bank branches [LOGCOMB(-1)], official exchange rate in the current period [LOGOEXC], and personal remittances received in the current period [LOGREMR] all have significant negative relationships with informal remittance channel (LOGICHAN).

The bottom line is that the interactive term, i.e., LOGOEXC*LOGREMR (official exchange rate * personal remittances received) has positive and significant influence on informal remittance channel (LOGICHAN) only in the short run. The implication is that government must take a strong step towards full exchange rate unification, i.e., closing the gap between the sole official rate and the parallel market rate by unifying both of them around the Nigerian Autonomous Foreign Exchange Rate Fixing mechanism (NAFEX) commonly referred to as the "Investors' and Exporters' FX Window". In addition, government, money transfer agents and commercial banks should continue to investments and support innovation in international digital money transfer. At the same time, commercial banks should expand their geographical footprint especially in areas with a low presence of financial institutions. This can be achieved by establishing agent locations in insufficiently served localities.

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