Impact of Personal Remittances on Monetary Policy Variables in Nigeria: An Autoregressive Distributed Lag (ARDL) Approach

James Tumba Henry[1], Enam Pagiel Abalis[2]

[1,2]*Department of Economics, Faculty of Social and Management Sciences, Adamawa State University, Mubi, Nigeria*

***Abstract*: - Nigeria is one of the countries with high personal remittances inflows in the world. However, these inflows have serious implications for the effectiveness or otherwise of the CBN's objective of price stability. This is because they are not properly tracked and captured when designing monetary policy targets. Thus, this study was conceived to investigate the impact of personal remittances on monetary policy variables within a linear Autoregressive Distributed Lag (ARDL) model. Three equations were developed and secondary data from 1980 to 2016 was assembled for this study. The hypotheses stated in this study were tested at 10% and 5% levels of significance. The result obtained revealed that personal remittances and consumer price index have a positive and significant impact on broad money supply in the long and short runs within the period of study. It was therefore recommended that the CBN should keep track of all remittances inflow into the country by enacting laws that will encourage the transfer of remittances through financial institutions and prohibits transfer through other means.**

***Keywords*: personal remittances, monetary policy targets, broad money supply**

I. INTRODUCTION

The major objective of monetary policy in Nigeria is to ensure price and monetary stability so as to foster sustainable and inclusive economic growth. This can only be achieved when the prices of goods and services in the home economy is kept low and stable over a given period of time. Mbutor (2010) opined that sound monetary policy can help achieve financial stability by attracting personal remittances especially in the form of savings. Conceptually, monetary policy refers to the process by which the central bank of a country manages the cost of credit and supply of money, often targeting an inflation rate or interest rate to ensure price stability. On the other hand, personal remittances are the money sent by a person or worker in a foreign land to his or her home country (Ruiz & Vargas-Silva, 2010). Remittances inflows are playing a significant role in the economies of many countries, especially economies of developing countries.

The Mundell-Fleming model argued that monetary authorities of a country cannot simultaneously maintain free capital movement, fixed exchange rate, and an independent monetary policy. This implies that free flow of capital in the form personal remittances have serious implication for the effectiveness or ineffectiveness of monetary policy in the economies of recipient countries including Nigeria.

According to the World Bank Migration and Remittances Fact Book (2016), Nigeria is the largest recipient of remittances in Sub-Sahara Africa with an estimated $19 billion, followed by Ghana ($2 billion), Senegal ($2 billion), Kenya ($1.7 billion), Uganda ($1.1 billion), Mali ($800 million), South Africa ($700 million), Liberia ($600 million), Ethiopia ($600 million) and Madagascar ($400 million). As a percentage of Gross Domestic Product (GDP), personal remittances account for about 4.6 percent of Nigeria's GDP. In the world, India is the largest recipient of remittances, followed by China, Philippines, Mexico, Pakistan, and Nigeria ranked sixth. In recipient economies, Immaculate and Peter (2016) opined that international remittances to a large extent affect personal income, prices of goods and services, asset prices and the entire financial system. This implies that they have the potentialities to interact and interfere with the smooth operations of monetary policy in the recipient countries.

Personal remittances to developing countries are procyclical, that is, they respond to business cycle and also promote change in cyclical patterns (Immaculate & Peter, 2016). Procyclical personal remittances inflows can affect contractionary and expansionary monetary policy measures. It can weaken tighter monetary policy and undermine expansionary monetary policy. Thus, international remittances inflow can affect the effectiveness of monetary policy transmission in the economies of high-recipient countries like Nigeria. Notably, the Central Bank of Nigeria (CBN) often target money supply, interest rates, and exchange rates to achieve the ultimate objective of price stability.

The Central Bank of Nigeria has made several efforts to improving monetary policy framework in the country through monetary aggregate targeting, inflation targeting, and exchange rate targeting. However, achieving the desired results is increasingly becoming difficult to achieve because the CBN does not take into account the cyclical properties of international remittances inflows when setting monetary policy targets. In view of this, the study seeks to investigate the impact of international remittances on monetary policy variables in Nigeria.

Research Hypothesis

H_0: Personal remittances do not have impact on monetary policy variables in Nigeria.

II. EMPIRICAL LITERATURE

There are few strands of literature on the relationship between personal remittances and monetary policy. Issahaku, Harvey and Abor (2016) used Panel-Vector Autoregressive (PVAR) model to investigate whether remittances entail extra risk for macroeconomic policy management and the role the financial system can play in the interaction between remittances and monetary policy. The study employed panel data of 106 developing countries from 1970 to 2013. The result revealed that remittances inflow reduces macroeconomic risk in developing countries while simultaneously stimulating a reduction in domestic interest rates. The study concluded that developing countries should take advantage of the positive impact of remittances in reducing macroeconomic instability by embarking on policies that can attract more remittance inflows.

Immaculate and Peter (2016) studied the relationship between remittance inflows and state-dependent monetary policy transmission in developing countries (Kenya, Mexico, Colombia and Philippines). The study employed quarterly data from 2000:Q1 to 2015:Q4 and estimated series of nonlinear (smooth-transition) local projections to study the effectiveness of monetary policy under different remittance inflows regimes. The result showed that monetary policy indeed has a smaller domestic effect under strong inflows of remittances and concluded that this has important implications for the design of inflation targeting in developing countries.

Contrary to the findings of Immaculate and Peter (2016), Ruiz and Vargas-Silva (2010) used Variance Decomposition and Impulse Response Function (IRF) to examine the response of monetary policy to international remittances in Mexico from January 1997 to February 2008. The result revealed that remittance inflows do not have a large impact on monetary policy. It was concluded that the main concern of Mexico's Central Bank is inflation targeting and that the appreciation of the Mexican currency due to increased remittances inflow is not a priority.

In Jamaica, Kemeisha (2010) used the Ordinary Least Square (OLS) estimation technique along with the traditional IS-MP model to investigate the impact that remittances have on the escalating exchange rate using annual data from 1995 to 2010. Controlling for other fundamental variables like government spending, official aid and terms of trade, the result showed that remittances depreciated the real exchange rate, contradicting many studies.

Similarly, Adenutsi and Christian (2008) explores the monetary factors underlying the changing levels of remittances inflows, and the implications of remittances inflows for monetary aggregates, interest rate, exchange rate and domestic price level in Ghana. The study used a five-variable Vector Autoregressive (VAR) model on quarterly data from 1983: Q4 to 2005: Q4. The result revealed that monetary aggregates, exchange rate, and interest positively impact on remittance inflows while domestic price level negatively impact on remittance inflows. It also showed that monetary aggregates, exchange rate, interest rate, and domestic price level impact on one another while remittances positively drive itself, monetary aggregates, exchange rate, and interest rate.

In Nigeria, Joseph and Okwudili (2015) investigated the impact of international remittances on the Nigerian economy. The study used Autoregressive Distributed Lagged Model (ARDL) to estimate time series data from 1981 to 2011. The result showed that international remittances inflow has positive and significant on the Nigerian economy proxied by GDP. The study concluded that a dollar increase in remittances inflows into the country will increase Nigeria's GDP by 0.1 billion naira through household consumption and private investment.

Mbutor (2010) used Vector Error Correction Model (VECM) with two stage deductions to evaluates the role of monetary policy in enhancing remittances for economic in Nigeria from 1970 to 2008. The result revealed that monetary policy rate first impact on intervening variables (exchange rate, interest rate, inflation, among others) which in turn impact remittance inflows. Similarly, it was shown that economic growth increases remittances to Nigeria while exchange rate depreciation depresses remittances. It was there concluded that stronger Naira is a sign of economic prosperity.

Augustine and Chekwube (2015) examined the relationship and causality that exist between remittances inflows and monetary aggregates, interest rate, exchange rate and domestic price level in Nigeria. The study adopted the Johansen and the Granger causality techniques using annual data from 1970 to 2013. The result revealed that there is a long-run relationship between the variables. The result also showed that unidirectional causality running from money supply to remittances only at lag and not in the reverse, causality run from exchange rate to remittances, unidirectional causality running from interest rate to remittances, bidirectional causality between inflation rate and remittances. The study concluded that exchange rate causes both remittances and monetary policy (money supply and interest rate) and monetary policy causes remittances.

III. SUMMARY OF RELATED LITERATURE AND RESEARCH GAP

Few studies have attempted to investigate the impact of personal remittances on monetary policy variables. Though there are a lot of interesting findings from these studies, many studies have not been done on Nigeria and some tend to be

conflicting and sometimes ambiguous to understand. Few of these studies are summarized in Table 1 below:

Table 1 Summary of Related Literature and Research Gap

Author(s)/Year of Study	Title and Scope	Variables	Method	Major Findings	Weakness
Immaculate and Peter (2017)	Remittance Inflows and State-Dependent Monetary Policy Transmission in Developing Countries: Kenya, Mexico, Colombia and Philippines (2000Q1-2015Q4)	Remittances, real GDP, consumer price index, exchange rate and government bond.	Non-linear smooth-transition model (local projections technique)	Monetary policy has smaller domestic effect under strong inflows of remittances.	Nigeria was not included in this study.
Joseph and Okwudili (2015)	The impact of international remittances on the Nigerian economy (1981-2011)	International remittances and Gross Domestic Product.	Autoregressive Distributed Lagged Model (ARDL)	International remittances inflow has a positive and significant impact on the Nigerian economy.	This study focused on economic growth rather than on specific monetary variables.
Adenutsi and Christian (2008)	Remittances, Exchange Rate, and Monetary Policy in Ghana (1983Q4-2005Q4)	Remittance inflows, monetary aggregates, treasury bill rate (a proxy for interest rate), exchange rate and domestic price level.	Five-variable Vector Autoregressive (VAR) Model	The estimated long-run model shows that monetary aggregates, exchange rate, and interest rate positively impact on remittance inflows while domestic price level negatively impacts on remittance inflows.	The conclusion in this study showed that it is focused on the impact of monetary policy variables and domestic price level on remittance rather than the impact of remittance inflows on monetary policy.

Source: Compiled by the Author

From the summarized literature above, this study attempts to add to existing knowledge on the relationship between remittances and monetary policy by specifically investigating the impact of personal remittances on monetary policy variables in Nigeria which most of the above study failed to do.

IV. METHODS AND DATA

4.1 Methods

This study subjected the data collected for each variable to a stationarity test to determine the presence or absence of unit root. The stationarity test was done using the Augmented Dickey-Fuller (ADF) test proposed by Dickey and Fuller in 1979. The essence of running a stationarity test is to help in the selection of the estimation technique to be used in this study. The ADF test is presented below as:

$$\Delta Y_t = \lambda_1 + \lambda_{2t} + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-1} + U_t$$

Where: U_t is the stochastic error term, t is time trend, Y_t is the variable of interest (LMS, INT, EXR, REM, and INF), λ_1, λ_2, $\boldsymbol{\delta}$ and α_i are parameters to be estimated, Δ is the difference operator. The ADF test is done to know whether $\boldsymbol{\delta} = 0$.

This study employed the Autoregressive Distributed Lag (ARDL) model to investigate the impact of personal remittances on monetary policy variables in Nigeria because the data are integrated of order I(0) and I(1). This technique was developed by Pesaran and Shin (1999) and improved by Pesaran, Shin and Smith (2001). This approach deals with the estimation of an Unrestricted Error Correction Model (UECM) with its several advantages over other cointegration techniques. First, the ARDL technique estimates the long and short run coefficients simultaneously, therefore, avoiding the problem of autocorrelation and omitted variables. Secondly, the ARDL F-statistic used in the bounds (Wald) testing procedure has non-standard distribution under the hypothesis of no long-run relationship among the variables under study, irrespective of whether they are integrated of order I(0), I(1) or a mixture of the two. Thirdly, this procedure gives unbiased estimates of the long-run model with a valid t-statistic even though some of the explanatory variables are endogenous.

Conventionally, pertinent questions of how macroeconomic policies are conducted in the presence of procyclical capital flows are discussed within the framework of Mundell (1963) and Fleming (1962) prepositions. Mundell-Fleming Model is, fundamentally, an extended IS-LM model in an open-economy setting. Based on the observed correlations as expressed in the literature between personal remittances and price stability in particular and monetary policy variables in general, this study adopted the flexible-price Mundell-Fleming model which is a linear logarithmic stochastic model following Clarida and Gali (1994) as used by Adenutsi and Christian (2008).

In this regard, this study used a disaggregated linear ARDL model to investigate the impact of personal remittances on monetary policy variables in Nigeria. This study avoids using simultaneous equation so as to know the impact of personal remittances on the individual monetary policy variables.

The monetary policy variables used for this study are money supply, interest rate, and exchange rate. This is because they are the monetary policy targets of the Central Bank of Nigeria if they want to pursue a specific macroeconomic objective. However, INF proxied by the consumer price index (CPI) was used as a control variable. The model for this study is specified below.

MPV = f (REM, INF)

Where: MPV is monetary policy variables and REM represents personal remittances inflow. Thus, MPV is disaggregated into broad money supply, interest rate, and exchange rate. This is important because it allows for an independent study of the impact of personal remittances on each of the variables. Hence, the above functional relationship can be expressed econometrically in line with the ARDL-UECM Pesaran et al. (2001) specification as:

Equation 1: Broad Money Supply and Personal Remittances

$$\Delta LMS_t = \lambda_0 + \lambda_1 LMS + \lambda_2 LREM_t + \lambda_3 INF_t + \sum_{i=0}^{k} \lambda_{4i}\, \Delta LMS_{t-1} + \sum_{i=0}^{k} \lambda_{5i}\, \Delta LREM_{t-1} + \sum_{i=0}^{k} \lambda_{6i}\, \Delta INF_{t-1} + U_1$$

Equation 2: Interest Rate and Personal Remittances

$$\Delta INT_t = \lambda_0 + \lambda_1 INT + \lambda_2 LREM_t + \lambda_3 INF_t + \sum_{i=0}^{k} \lambda_{4i}\, \Delta INT_{t-1} + \sum_{i=0}^{k} \lambda_{5i}\, \Delta LREM_{t-1} + \sum_{i=0}^{k} \lambda_{6i}\, \Delta INF_{t-1} + U_2$$

Equation 3: Exchange Rate and Personal Remittances

$$\Delta EXR_t = \lambda_0 + \lambda_1 EXR + \lambda_2 LREM_t + \lambda_3 INF_t + \sum_{i=0}^{k} \lambda_{4i}\, \Delta EXR_{t-1} + \sum_{i=0}^{k} \lambda_{5i}\, \Delta LREM_{t-1} + \sum_{i=0}^{k} \lambda_{6i}\, \Delta INF_{t-1} + U_3$$

Where: LMS is the natural log of money supply at time t, $LREM_t$ is the natural log of personal remittances at time t, INT_t is lending interest rate at time t, EXR_t is official exchange rate at time t, INF is inflation rate, λ_0, λ_1, and λ_2 are parameter estimates, Δ is the first difference operator and U_1 to U_3 are the stochastic error term.

Autoregressive Distributed Lag (ARDL) procedures use three steps to evaluate the relationship among variables in a model. First, equations 1 to 3 were estimated using Ordinary Least Square (OLS) to know if a long-run relationship exists among the variables by conducting an F-test for the joint significance of the coefficients of the lagged level variables.

The hypotheses are:

$\boldsymbol{H_0}$ **:** $\lambda_1 = \lambda_2 = \lambda_3 = 0$, this implies there is no long-run relationship.

$\boldsymbol{H_1}$ **:** $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq 0$, this implies there is long-run relationship.

To reach a conclusion after estimating the ARDL bounds test for cointegration, two sets of critical value bounds with the F-statistic are generated by Pesaran et al. (2001). If the computed F-statistic is below the lower critical values, the null hypothesis of no long-run relationship is accepted. On the other hand, if computed F-statistic is above the upper critical values, the alternate hypothesis is accepted, which implies there is a long-run relationship among the variables in the equations. However, if the F-statistic is within the critical bounds, this implies the result is inconclusive.

Secondly, after establishing long-run relationship among the variables using the ARDL bounds test for cointegration, the conditional long-run model for each of the equations was estimated. This involves selecting the orders of the ARDL (a, b) model using Akaike Information Criterion (AIC) or Schwartz-Bayesian Criterion (SBC). Finally, the short-run dynamic parameters by estimating an Error Correction Model (ECM) associated with the long-run estimates are obtained. This gives the short-run dynamic coefficients of the models' convergence to equilibrium in the long-run. Similarly, it gives the speed of adjustment parameters and the error correction term obtained from the estimated equilibrium relationship of equations 1 to 3.

4.2 Data and Source

This study used secondary data (annual) from 1980 to 2016 to investigate the impact of personal remittances on monetary policy variables in Nigeria. The key variable (REM) whose measurement was in US dollar as reported by the World Bank Development Indicator (WDI) was converted into naira using the official exchange rate for each year to multiple the personal remittances inflow into Nigeria.

Table 2: Description of Variables in the Model

Variable	DESCRIPTION	SOURCE(S)	A PRIORI EXPECTATION
MS	Broad money supply (M2) proxy for monetary aggregates in millions of naira	World Bank World Development Indicator.	Dependent variable
INT	Lending interest rate proxy for interest rate in %	World Bank World Development Indicator.	Dependent variable
EXR	Official exchange rate of the Naira relative to the US dollar	World Bank World Development Indicator.	Dependent variable
REM	Personal Remittances inflow into Nigeria in millions of naira	World Bank World Development Indicator.	+
INF	Consumer Price Index (CPI) was used as proxy for inflation rate in %	World Bank World Development Indicator.	-

Source: Compiled by the Author

V. ANALYSIS AND RESULTS

In order to avoid spurious results associated with regression models involving time series (Gujarati & Porter, 2009), this study subjected the data to a stationary test using the Augmented Dickey-Fuller (ADF) test as proposed by Dickey and Fuller (1979). The results obtained are presented in Table 3 below:

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

Variables	Level (t-statistic)	1st Difference(t-statistic)	Order of Integration
LMS	-0.567148	-3.522603	I(1)
INT	-2.338434	-5.214897	I(1)
EXR	-1.394970	-3.678066	I(1)
LREM	-0.767499	-7.140767	I(1)
INF	-3.629574	_____	I(0)
Test Critical Values (Level and 1st Difference): 5% = -2.951125, 10% = -2.614300			

Source: Computed by the Author (Eviews 9)

The ADF results in Table 3 shows that MS, INT, EXR, and REM are stationary after first difference, that is, they are integrated of order I(1). This is because their t-statistics are greater than the test critical values after differencing the variables ones at 5% and 10% level of significance. On the other hand, INF is stationary at level, that is, it is integrated of order I(0). This is because the t-statistic is greater than the test critical value at level. This implies that the variables are a mixture of I(0) and I(1), thus, cointegration test of Engel-Granger (1987), Johansen (1988) and Johansen-Juselieus (1990) cannot be employed to test for the long-run relationship among the variables in the equations developed for this study. This is because INF which is I(0) appears in all the equations and the cointegration tests mention above requires that all the variables must be I(1).

5.1 Broad Money Supply and Personal Remittances Equation

Having established the order of integration, the study proceeded to ascertain if there is a long-run relationship among the variables in equation 1 using the ARDL bounds testing procedure for cointegration and the result is presented in Table 4 below:

Table 4: ARDL Bounds Test for Cointegration (Equation 1)

Test Statistic	Value	K
F-Statistic	2427.448**	2
Critical Value Bounds		
Significance Level	**I(0) Bound**	**I(1) Bound**
10%	3.17	4.14
5%	3.79	4.85
Note: ** indicates that the computed F-Statistic falls above the upper bound values at 5% and 10% levels		

Source: Computed by the Author (Eviews 9)

Table 4 above shows the result of the ARDL bounds test for cointegration for equation 1 (broad money and personal remittances equation). The first step in this procedure is to compare the value of the calculated F-statistic with the Pesaran et al. (2001) critical value bounds. Accordingly, the estimated F-statistic of 2427.448 calculated at k=2 (number of explanatory variables) exceeds the upper critical bound at 10 and 5 percent levels. Hence, the null hypothesis of no long-run relationship among the variables in equation 1 is rejected. This implies that there is a long-run relationship between the variables. The next step is to investigate the long-run and short-run marginal impacts of personal remittances on the broad money supply. The result is presented in Table 5 and 6 below.

Table 5: Estimated Long Run Coefficients (Equation 1)

ARDL(1, 0, 0) Selected Automatically Based on Akaike Information Criterion Dependent Variable: LMS				
Variable	**Coefficient**	**Std. Error**	**t-statistic**	**Probability**
LREM	0.493791	0.034698	14.231167*	0.0000
INF	0.908858	0.311258	2.919953*	0.0064
Note: * indicates significance at 5% and 10% levels				

Source: Computed by the Author (Eviews 9)

Using ARDL (1, 0, 0) model selected automatically based on Akaike Information Criterion (AIC), the estimated long-run impacts obtained by normalizing on broad money supply (LMS) are reported in Table 5. The long-run coefficients of personal remittances (LREM) and consumer price index (INF) are positive and statistically significant as shown by the t-statistic and probability values at 5 and 10 percent levels. The sign of the coefficient of LREM variable supports the assertion that a country cannot simultaneously maintain free capital movement in the form of personal remittances and still maintain an independent monetary policy. The coefficient of LREM (0.49) means that a 1 percent increase in personal remittances inflows into Nigeria will increase the broad money supply by 49 percent. This implies that personal remittances have serious implication for the effectiveness of money policy in Nigeria.

Similarly, the coefficient of INF (0.90) means that 1 percent increase in the prices of goods and services in Nigeria will increase the broad money supply by 90 percent. This is because when prices of goods and services increase caused by other factors than demand-pull inflation in the economy, there is a tendency that people will increase their spending to cope up with the price increase, thus increasing money supply. This finding is contrary to the a priori expectation of this study because an increase in price level is expected to reduce money supply.

Table 6: Error Correction Model (Equation 1)

ARDL(1, 0, 0) Selected Automatically Based on Akaike Information Criterion Dependent Variable: LMS				
Variable	**Coefficient**	**Std. Error**	**t-statistic**	**Probability**
D(LREM)	0.004082	0.001402	2.911137*	0.0065
D(INF)	0.007514	0.000098	76.907501*	0.0000
CoinEq(-1)	-0.008267	0.002774	-2.980581*	0.0055
Cointeq = LMS - (0.4938*LREM + 0.9089*INF + 18.5358)				
R-squared	0.999990	Mean dependent var	27.14002	
Adjusted R-squared	0.999989	S.D. dependent var	2.486077	
S.E. of regression	0.008344	Akaike info criterion	-6.630076	
Sum squared resid	0.002228	Schwarz criterion	-6.454129	
Log likelihood	123.3414	Hannan-Quinn criter.	-6.568666	
F-statistic	1035639.	Durbin-Watson stat	1.661952	
Prob(F-statistic)	0.000000			
Note: * indicates significance at 5% and 10% levels				

Source: Computed by the Author (Eviews 9)

The short-run dynamic result above also shows that personal remittances (LREM) and consumer price index (INF) have a positive and significant impact on broad money supply in Nigeria. Though, the impacts are small as shown by their coefficients but are also significant as revealed by their t-statistic and probability values. This is in conformity with the findings in the long-run estimates.

Finally, the cointegrating equation [CoinEq (-1)] in Table 6 above represents the error correction mechanism (ECM). The ECM shows how the short-run disequilibrium behavior of an economic variable is corrected in the long-run. In other words, the error correction variable captures the short-run dynamics of the equation and its coefficient measures the speed of adjustment in the event of a shock to the system. The error correction variable is statistically significant and correctly signed. This reflects the joint significance of the long-run coefficients. The estimated ECM coefficient is -0.008267. This indicates a very slow speed of adjustment to equilibrium after a shock. In specific terms, approximately 1 percent of the short-run disequilibrium from the previous year's shock converges back to long-run equilibrium in the current year. Similarly, the overall regression result of equation 1 is significant at 5 and 10 percent level of significance as shown by the R-squared and F-statistic. The R-squared value of 0.999990 indicates that 99 percent of the variation in the dependent variable is explained by the independent variables in equation 1. The F-statistic probability value of 0.000000 suggests the joint significance of the determinants in the error correction model. The D-W statistic of 1.661952 indicates that there is no serial correlation in the residuals.

5.2 Interest Rate and Personal Remittances Equation

In addition to the stationarity test in Table 3 above, the study also proceeded to ascertain if a long-run relationship exists among the variables in equation 2 using the ARDL bounds testing procedure and the result is presented in Table 7 below:

Table 7: ARDL Bounds Test for Cointegration (Equation 2)

Test Statistic	**Value**	**K**
F-Statistic	4.722279*	2
Critical Value Bounds		
Significance Level	**I(0) Bound**	**I(1) Bound**
10%	3.17	4.14
5%	3.79	4.85
Note: * indicates that the computed F-Statistic falls above the upper bound value at 10% only		

Source: Computed by the Author (Eviews 9)

From Table 7 above, the estimated F-statistic of 4.722279 calculated at k=2 (number of explanatory variables) exceeds the upper critical bound at 10 percent level of significance but fall within the critical bounds at 5 percent levels. Hence, the null hypothesis of no long-run relationship among the variables in equation 2 is rejected at 10 percent level of significance but accepted at 5 percent level. This implies that there is a long-run relationship among the variables at 10 percent level but inconclusive at 5 percent level. Thus, it is concluded that there is a partial relationship among the variables in equation 2. The next step is to investigate the long-run and short-run marginal impacts of personal remittances on interest rate. The result is presented in Table 8 and 9 below.

Table 8: Estimated Long Run Coefficients (Equation 2)

ARDL (4, 2, 0) Selected Automatically Based on Akaike Information Criterion Dependent Variable: INT				
Variable	**Coefficient**	**Std. Error**	**t-statistic**	**Probability**
LREM	0.087972	0.266961	0.329532	0.7446
INF	0.102938	0.064578	1.594007	0.1240

Source: Computed by the Author (Eviews 9)

Using ARDL (4, 2, 0) model selected automatically based on Akaike Information Criterion (AIC), the estimated long-run impacts obtained by normalizing on the lending interest rate (INT) are reported in Table 8. The long-run coefficients of personal remittances (LREM) and consumer price index (INF) are positive but not statistically significant as shown by the t-statistic and probability values at 5 and 10 percent levels. This implies that personal remittances and

consumer price index do not have a serious impact on the lending interest rate. This finding explains why there is a partial relationship among the variables in equation 2 as suggested by the bounds test.

Table 9: Error Correction Model (Equation 2)

ARDL (4, 2, 0) Selected Automatically Based on Akaike Information Criterion Dependent Variable: LMS				
Variable	**Coefficient**	**Std. Error**	**t-statistic**	**Probability**
D(INT(-1))	-0.014333	0.177771	-0.080627	0.9364
D(INT(-2))	-0.035483	0.169876	-0.208877	0.8363
D(INT(-3))	0.431590	0.162459	2.656607	0.0138*
D(LREM)	0.825659	0.526668	1.567702	0.1300
D(LREM(-1))	0.853132	0.530365	1.608574	0.1208
D(INF)	0.046122	0.029736	1.551018	0.1340
CointEq(-1)	-0.448055	0.133688	-3.351493	0.0027*
Cointeq = INT - (0.0880*LREM + 0.1029*INF + 12.4856)				
R-squared	0.742845	Mean dependent var		18.53378
Adjusted R-squared	0.657126	S.D. dependent var		4.464977
S.E. of regression	2.614487	Akaike info criterion		4.987013
Sum squared resid	164.0530	Schwarz criterion		5.395152
Log likelihood	-73.28572	Hannan-Quinn criter.		5.124340
F-statistic	8.666097	Durbin-Watson stat		1.971542
Prob(F-statistic)	0.000017			
Note: * indicates significance at 5% and 10% levels				

Source: Computed by the Author (Eviews 9)

The short-run dynamic result for equation 2 above shows that the coefficients of personal remittances (LREM) and consumer price index (INF) are positive but not statistically significant. This is because the difference value of personal remittances in the current year [D(LREM] and last year [D(LREM(-1)] and difference value of consumer price index in the current year [D(INF] are not significant as revealed by their t-statistic and probability values. This is in conformity with the findings in the long-run estimates. However, the difference value of lending interest rate [D(INT(-3))] in the last three years is positive and statistically significant while that of the last two years and previous year are negative but not significant.

Finally, the cointegrating equation [CoinEq (-1)] in Table 9 above represents the error correction mechanism (ECM). The error correction variable is statistically significant and correctly signed. The estimated ECM coefficient is -0.448055. This indicates a very slow speed of adjustment to equilibrium after a shock. In specific terms, approximately 45 percent of the short-run disequilibrium from the previous year's shock converges back to long-run equilibrium in the current year. Similarly, the overall regression result of equation 2 is significant at 5 and 10 percent level of significance as shown by the R-squared and F-statistic. The R-squared value of 0.742845 indicates that 74 percent of the variation in the dependent variable is explained by the independent variables in equation 2. The F-statistic probability value of 0.000017 suggests joint significance of the determinants in the error correction model. The D-W statistic of 1.971542 indicates that there is no serial correlation in the residuals.

5.3 Exchange Rate and Personal Remittances Equation

In addition to the stationarity test in Table 3 above, the study also proceeded to ascertain if a long-run relationship exists among the variables in equation 3 using the ARDL bounds testing procedure and the result is presented in Table 10 below:

Table 10: ARDL Bounds Test for Cointegration (Equation 3)

Test Statistic	**Value**	**K**
F-Statistic	0.952206!	2
Critical Value Bounds		
Significance Level	**I(0) Bound**	**I(1) Bound**
10%	3.17	4.14
5%	3.79	4.85
Note:! indicates that the computed F-Statistic falls below the lower bound values at 5% and 10% levels		

Source: Computed by the Author (Eviews 9)

From Table 10 above, the estimated F-statistic of 0.952206 calculated at k=2 (number of explanatory variables) falls within the critical bounds at 10 percent and 5 percent levels of significance. Hence, the null hypothesis of no long-run relationship among the variables in equation 3 is accepted. This implies that there is no long-run relationship among the variables at 10 percent and 5 percent levels. Thus, it is concluded that there is no long-run relationship between exchange rate, personal remittances and consumer price index in Nigeria.

VI. DISCUSSION OF FINDINGS

Results obtained from the estimated equations shows some interesting findings. These findings are discussed below:

Broad Money Supply and Personal Remittances Equation

Long and short run coefficients of personal remittances (LREM) and consumer price index (INF) have a positive and significant impact on broad money supply (LMS). This implies that personal remittances and consumer price index are important factors that influence the volume of money in circulation in Nigeria. Thus, increases in personal remittances inflows and prices of goods and services have serious implication for the effectiveness of contractionary monetary policy. This result supports the Mundell-Fleming proposition that a country cannot allow free capital movement and still maintain an independent monetary policy. This also conforms to the findings of Issahaku et al. (2016) and Adenutsi and Christian (2008).

Interest Rate and Personal Remittances Equation

Long and short run coefficients of personal remittances (LREM) and consumer price index (INF) have a positive and insignificant impact on the lending interest rate (INT). This implies that personal remittances and consumer price index do not influence the lending interest rate in Nigeria. Thus, an increase in personal remittances inflows and prices of goods and services do not have implication for interest rate target. This result contradicts the Mundell-Fleming proposition that a country cannot allow free capital movement and still maintain an independent monetary policy. This also conforms to the finding of Adenutsi and Christian (2008) that found a positive relationship between remittances and interest rate though not significant in this study.

Exchange Rate and Personal Remittances Equation

The ARDL bounds test for cointegration revealed that there is no long-run relationship among the variables in the exchange rate and personal remittances equation. This implies that personal remittances (LREM) and consumer price index (INF) do not have an impact on exchange rate in Nigeria. This contradicts the finding of Kemeisha (2010) and Adenutsi and Christian (2008).

VII. CONCLUSION AND RECOMMENDATIONS

This study was conducted to investigate the impact personal remittances have on monetary policy variables in Nigeria by employing secondary data from 1980 to 2016. The Autoregressive Distributed Lag (ARDL) techniques were used to estimate the relationships among variables in the three equations developed for this study. The empirical results showed that personal remittances inflows and consumer price index have a serious influence on broad money supply in Nigeria. This implies that personal remittances inflows and consumer price index can weaken the effectiveness of monetary policy if the CBN wants to pursue contractionary monetary measures by reducing the volume of money in circulation. Similarly, personal remittances and consumer price index do not have a significant impact on the lending interest rate and exchange rate within the period of this study.

Based on the findings above, it is recommended that the Central of Nigeria should keep track of all personal remittances inflows into the country by enacting laws that will encourage the transfer of remittances through financial institutions and prohibits transfers through other means like friend-to-relative-transfer. This will enable the CBN to have adequate data of the amount of personal remittances inflows into the country and incorporate it into her monetary policy framework. Similarly, the CBN should sincerely pursue inflation targeting so has to avoid hyper-increase in the prices of goods and services that can force people to increase their spending unnecessarily.

REFERENCES

[1]. Adenutsi, D. O., & Christian, R. K. A. (2008). Remittances, exchange rate and monetary policy in Ghana. *West African Journal of Monetary and Economic Integration, 8(2),* 1-42.

[2]. Augustine, C. O., & Chekwube, V. M. (2015). Remittances, exchange rate and monetary policy in Nigeria. *Global Journal of Management and Business Research: B Economics and Commerce, 15(6),* 1-7.

[3]. Gujarati, D. N., & Porter, D. C. (2009). *Essentials of Econometrics* (4th ed.), New York: NY, McGraw-Hill/Irwin.

[4]. Gujarati, N. D., Porter, C. D., & Gunasekar, S. (2009). Basic econometrics: Special Indian Edition (5th ed.) New Delhi: McGraw Hill.

[5]. Immaculate, M., & Peter, T. (2016). Remittance inflows and state-dependent monetary policy transmission in developing countries. *Beitrage Zur Jahrestagung des Vereins fur Socialpolitik, B15-V3,* 1-33. Retrieved from https://editorialexpress.com/cgi-bin/conference/download.cgi?

[6]. Issahaku, H., Harvey, S. K., & Abor, J. Y. (2016). Does development finance pose an additional risk to monetary policy?. *Review of Development Finance*, 6(2016), 91-104. Retrieved from http://dx.doi.org/10.1016/j.rdf.2016.06.001

[7]. Joseph, C. O., & Okwudili, B. E. (2015). The impact of international remittances on the Nigerian economy. *British Journal of Economics, Management & Trade, 7(1),* 1-9.

[8]. Kemeisha, B. (2010). The effect of remittances on the real exchange rate: The case of Jamaica. *Caribbean Centre for Money and Finance, 1-18.*

[9]. Mbutor, O. M. (2010). Can monetary policy enhance remittances for economic growth in Africa? The case of Nigeria. *Journal of Economics and International Finance, 2(8),* 156-163. Retrieved from http://www.academicjournals.org/jeif

[10]. Ruiz, I., & Vargas-Silva, C. (2010). Monetary policy and international remittances. *The Journal of Developing Areas*, 43 (2), 173-186. Retrieved from https://www.jstor.org/stable/40376256

[11]. World Bank Group. (2016). Migration and remittances factbook (3rd Ed.). Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/23743/9781464803192.pdf