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Modelling the Causal Relationship among Remittances, Exchange Rate, and Monetary Policy in Nigeria

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ABSTRACT
This study examined the relationship and causality that exist between remittance inflows exchange rate and monetary aggregates - money supply, interest rate, and the domestic price level in Nigeria. The Johansen co-integration and the Granger causality techniques were employed. The Johansen co-integration test indicated that long run relationship exist among the variables. The Granger causality test results revealed a unidirectional causality running from money supply (LM2) to remittances (LREM) only at lag one and not in the reverse. In other lags, there was no evidence of causality between the duos. The results also showed that, consistently from lag one to lag five, causality run from exchange rate (LEXR) to LREM and not in reverse direction. Unidirectional causality run from interest rate (INT) to LREM, occurring from lag one to lag four. There was no evidence of causality in any direction between inflation rate (INF) and LREM within these lags. We also found that causality run from exchange rate (LEXR) to money supply (LM2) only at lags one and four and not in the reverse order.
Keywords: Remittance Inflows, Exchange Rate, and Monetary Policy.

1. Introduction

Remittance is a transfer of money by a foreign worker to an individual in his or her home country. According to the Nigerian Tribune of 8th September, 2014, the second biggest source of foreign exchange earnings for Nigeria is remittances sent home by Nigerians living abroad, coming next to petrodollars. It further reported that in 2014, 17.5 million Nigerians lived in foreign countries, with the UK and the USA having more than 2 million Nigerians each. From a macroeconomic perspective, remittances inflow has the potential to enhance aggregate demand and thus Gross Domestic Product (GDP) as well as induce economic growth. However, some studies have reported mixes effects of remittances on the real exchange rate. For instance, Sultonov (2011) discovered that huge remittances led to appreciation of Tajikistan's real exchange rate whereas Barrett (2014) on the contrary found that remittances depreciate the Jamaica's real exchange rate.

Interest in examining the role of remittances in economic growth has remained obvious in the recent times. It has been acknowledged that remittances serve as a vital source of development finance in most developing countries. In the face of deteriorating official development aid, precariously internally generated revenue and scanty private capital inflows, remittances complement scarce domestic resources. Remittances have the potential to enhance socio-economic prospects of countries. It serve as a source of development finance through direct investment in the money and capital markets of beneficiary countries. Further, it has been documented that remittances, in a range of ways can spur exports, and therefore improve the Balance of Payments (BoP) and international reserves of the beneficiary country.

Consequently, the key research questions answered in this study are: Is there any long-run relationship between remittances inflow, exchange rate and monetary policy variables? What monetary policy variables explain the inflow of remittances in Nigeria? Does remittances cause monetary policy and vice versa? Based on the foregoing, this paper, explored the effects and causality that exist among remittance inflows, exchange rate, and monetary policy in Nigeria. The remainder of this paper is structured as follows. Section 2 focuses on review of related literature whereas Section 3 briefly describes the theoretical framework and Methodology adopted in the study. Section 4 presents and discusses the empirical results while section 5 concludes the study.

2. Review of related literature

The literature linking remittances, exchange rate, and monetary policy remains inconclusive and is still expanding. The empirical findings emanating from the existing studies seem not to go in the same direction as they are replete with divergent views. For instance, within the context of the Ghanaian macroeconomy, Adenutsi and Ahortor (2008) explored the monetary factors underlying the changing levels of remittance inflows, and the implications of remittance inflows for monetary aggregates, interest rate, exchange rate, and the domestic price level. The theoretical framework of the study was based on a modified variable-price Mundell-Fleming model. They estimated a five variable Vector Autoregressive (VAR) Model using quarterly data between 1983(4) and 2005(4). The estimated static long-run model revealed that monetary aggregates, exchange rate, and interest rate positively impact on remittance inflows while domestic price level negatively impact on remittance inflows. 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. The impulse response functions of the study showed that remittance inflows respond to its own shocks but not to shocks emanating from monetary aggregates, exchange rate, interest rate, and the price level. Variance decompositions indicated that, during the first quarter, remittances are self-driven. They recommended that prudent monetary and exchange rate policies should be specially formulated and selectively conducted to attract international remittances into Ghana.

In a bid to provide empirical answer to the research question of “can monetary policy enhance remittances for economic growth in Africa?”, Mbutor (2010) evaluated the role of monetary policy in enhancing remittances for economic growth, using Nigeria as a case study. The vector autoregressive methodology was applied with two stage deductions. The findings of the study revealed that the monetary policy rate first impacts intervening variables - exchange rate, interest rate, inflation - which in turn impact remittance flows. The data set were tested for temporal properties, including unit roots and co-integration. Preliminary evidence showed that domestic economic prosperity increases remittances to Nigeria; while exchange rate depreciation depresses remittances. In his view, the latter outcome reflects remitters’ perception that a stronger Naira is a sign of things-getting-better-back-home.

Using data for the Philippines, Mandelman (2011) developed and estimated a heterogeneous agent model to analyze the role of monetary policy in a small open economy subject to sizable remittance fluctuations. He tested whether remittances are countercyclical and serve as an insurance mechanism against macroeconomic shocks. When evaluating the welfare implications of alternative monetary rules, he considered both an anticipated large secular increase in the trend growth of remittances and random cyclical fluctuations around this trend. According to him, in a purely deterministic framework, a nominal fixed exchange rate regime avoids a rapid real appreciation and performs better for recipient households facing an increasing trend for remittances. He concluded that a flexible floating regime is preferred when unanticipated shocks driving the business cycle are also part of the picture.

Ball et al. (2012) examined the dynamic and desirable properties of monetary regimes in a remittances recipient economy, with an emphasis on the effect on sectoral output and nontradable inflation dynamics. Their findings indicated that under a fixed exchange rate regime, an increase in remittances creates increased demand for nontradable goods, and hence a rise in nontradable inflation as well as expansion in output of nontradables. Under a nontradable inflation targeting regime, however, they found that a decrease in nontradable inflation, and an expansion in tradable goods production following an increase in remittances.

This paper, therefore, provides an essential contribution to the literature by exploring the relationship and causality that exist between remittance inflows, exchange rate and monetary aggregates - interest rate and the domestic price level in Nigeria.

3. Theoretical framework and methodology

3.1. Theoretical framework

In line with Adenutsi and Ahortor (2008) reviewed earlier, this study follows with modifications the Mundell-Fleming Model (Mundell, 1963; Fleming, 1962) which aptly answers the question of how macroeconomic policies are conducted in the presence of capital flows. Essentially, a Mundell-Fleming Model is an extended IS-LM model in an open-economy setting. The Model is riddled with some drawbacks; i) it is static and do not consider the dynamic effects of capital and asset accumulations, hence, connections between flows and stocks are ignored, ii) it is mainly concerned with once-and-for-all adjustments in key variables and iii) it is deficient in analysing long-run dynamic effects. In order to overcome these challenges we followed the model of Adenutsi and Ahortor (2008) in formulating the open-economy model of this study. The reason for that is that the model is capable of predicting the impact of domestic and external shocks as well as the co-movement of macroeconomic variables at home and abroad. Given that the model considers the economy from the general equilibrium perspective, it establishes interdependencies among the system variables, thus addressing the well-known inadequacies of the traditional Mundell-Fleming models. We therefore operationalize a deterministic and dynamic model in this study.

3.2. Methodology

Co-integration and causality test were used in this study to examine the relationship between remittances, exchange rate, and monetary policy in Nigeria. We adopted the Johansen co-integration and the Granger causality techniques to check if there is long run and causal relationship between the selected macroeconomic variables - remittance inflows (REM), exchange rate (EXR), and monetary policy variables (money supply (M2) and interest rate (INT)). Leaning on the work of Adenutsi and Ahortor (2008), inflation rate (INF) was added to capture the effect of price increase. The study used time series annual data that spans 1970 to 2013 to provide answers to the already set out research questions. The data pertaining to the chosen variables were obtained from WDI (2013).

3.2.1. Unit root test

It is widely known that co-integration analysis based on Johansen approach requires that variables of interest be integrated of the same order, basically order one. Therefore, it is customary that the first stage of co-integration analysis following the Johansen approach is to determine the order of integration of the chosen time series variables. The various methods used to test variables for unit root include the Augmented Dickey-Fuller (ADF) unit root test, Dickey-Fuller (DF) unit root test, Philip-Perron (PP) unit root test, Ng-Perron modified unit root test, among others. This study used the ADF unit root test. However, it is widely acknowledged that ADF may produce bias results in the face of structural breaks and that it is sensitive to the number of observations. Due to these shortcomings, we complemented the ADF unit root test with the Philip-Perron (PP) unit root test. It is imperative to note that while the ADF approach accounts for the autocorrelation of the first differences of a series in a parametric fashion by estimating additional nuisance parameter, the PP deals with the phenomenon in a non-parametric way. In other words, the PP unit root test makes use of non-parametric statistical methods without adding lagged difference term (Gujarati and Porter, 2009). Our ADF test consists of estimating the following equation:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

Where ε_t is a pure white noise error term; t is time trend; Y_t is the variable of interest; β_1, β_2, δ and α_i are parameters to be estimated; and Δ is the difference operator. In ADF approach, we test whether $\delta = 0$. The Philips-Perron test is based on the following statistic:

$$\tilde{t}_\alpha = t_\alpha \left(\frac{\gamma_0}{f_0}\right)^{1/2} - \frac{T(f_0 - \gamma_0)(se(\hat{\alpha}))}{2 f_0^{1/2} s} \quad (2)$$

Where $\hat{\alpha}$ is the estimate; $\tilde{t}_\alpha$ is the t-ratio of α; se($\hat{\alpha}$) is the coefficient standard error and s is the standard error of the regression. Also, γ_0 is a consistent estimate of the error variance in the standard Dickey-Fuller test equation (calculated as $(T-k)s^2/T$, where k is the number of regressors). The term f_0 is the estimator of the residual spectrum at zero frequency.

3.2.2. Co-integration test

Co-integration basically refers to the long run relationship between variables under study. As stated earlier, in this study, we adopted the Johansen co-integration approach to determine if long run relationship exists among the variables of interest. The test is based on estimating the following vector autoregressive (VAR) model:

$$\Delta Z_t = A_1 Z_{t-1} + \ldots\ldots + A_p Z_{t-p} + \beta Y_t + \mu_t \quad (3)$$

Where: Z_t is a k-vector of non-stationary variables; Y_t is a d-vector of deterministic variables; and μ_t is a vector of innovations. This can be rewritten as:

$$\Delta Z_t = \pi Z_{t-1} + \sum_{i=1}^{p=1} \Gamma_t \Delta Z_{t-i} + \beta Y_t + \mu_t \quad (4)$$

Where

$$\Pi = \sum_{i=1}^{p} A_i - I, \;\; \Gamma_i = -\sum_{j=i+1}^{p} A_j - - - - - - - - - - - - - - - (5)$$

In the Granger's representation theorem, if the coefficient matrix Π has reduced rank r < k, then there exist k x r matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta' Z_t$ is I(0); r is the number of co-integrating relations (i.e the rank) and each column of β is the co-integrating vector and the elements of α are the adjustment parameters in the vector error correction model. In general, the Johansen's approach is to estimate the Π matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of Π.

3.2.3. Granger causality test

The existence of long run relationship (co-integration) between two variables entails THE possibility of causality, at least, in one direction. It is one of the major thrust of this study to determine not only the long run relationship between remittances, exchange rate, and monetary policy in Nigeria but also to trace the causal relationship (if any) among them. Thus, the Pairwise Granger causality test was employed. The test is a statistical test of hypothesis for determining whether a time series is useful in forecasting another. When a time series X Granger causes another time series Y, it follows that the pattern in X is approximately repeated in Y after some time lags. Put succinctly, a time series X is said to Granger cause a time series Y if and only if it can be clearly shown through series of t-tests and F-tests on the lagged values of X (with lagged values of Y inclusive) that all the lagged X values provide statistically significant information about the future values of Y. The null hypothesis underlying the Granger causality test is that the variable under study (say X) does not Granger-cause the other (say Y). Originally, the Granger causality test is based on estimating a pair of regression models in the following generic fashion:

$$Y_t = \sum_{i=1}^{n} \alpha_i Y_{t-1} + \sum_{j-1}^{n} \beta_i X_{t-j} + v_{1t} - - - - - - - - - (6)$$

$$X_t = \sum_{i=1}^{n} \delta_i Y_{t-1} + \sum_{j-1}^{n} \lambda_i X_{t-j} + v_{2t} - - - - - - - - - (7)$$

Where, it is assumed that v_{1t} and v_{2t} are uncorrelated. In the above specification, according to Granger (1969), X is said to Granger-cause Y if β_i is not equal to zero and Y will also Granger-cause X if λ_i is not equal to zero. If these two situations simultaneously exist, then there is bi-directional causality. The first two scenarios represent unidirectional causality and if none of them prevails, then we conclude that there is independence between the two variables X and Y. This situation represents the simplest form of Granger causality specification which involves only two variables (X and Y), dealing with bilateral causality. However, in this study, the situation is more complex, involving five macroeconomic variables which can be extended to multivariable causality through the technique of vector autoregression (VAR). Thus, our Granger causality test is based on estimating the following VAR model:

$$LREM_t = \textstyle\sum_{i=1}^{n} \alpha_i LREM_{t-i} + \sum_{j=1}^{n} \beta_j LM2_{t-j} + \sum_{k=1}^{n} \delta_k LEXR_{t-k} + \sum_{l=1}^{n} \lambda_l INF_{t-l} + \sum_{p=1}^{n} \Psi_p INT_{t-p} + \mu_{1t} - - - - - - - - - - - (8)$$

$$LM2_t = \textstyle\sum_{i=1}^{n} \gamma_i LREM_{t-i} + \sum_{j=1}^{n} \theta_j LM2_{t-j} + \sum_{k=1}^{n} \eta_k LEXR_{t-k} + \sum_{l=1}^{n} \chi_l INF_{t-l} + \sum_{p=1}^{n} \Omega_p INT_{t-p} + \mu_{2t} - - - - - - - - - - - (9)$$

$$LEXR_t = \textstyle\sum_{i=1}^{n} a_i LREM_{t-i} + \sum_{j=1}^{n} b_j LM2_{t-j} + \sum_{k=1}^{n} c_k LEXR_{t-k} + \sum_{l=1}^{n} d_l INF_{t-l} + \sum_{p=1}^{n} e_p INT_{t-p} + \mu_{3t} - - - - - - - - - - - (10)$$

$$INF_t = \textstyle\sum_{i=1}^{n} g_i LREM_{t-i} + \sum_{j=1}^{n} h_j LM2_{t-j} + \sum_{k=1}^{n} r_k LEXR_{t-k} + \sum_{l=1}^{n} s_l INF_{t-l} + \sum_{p=1}^{n} v_p INT_{t-p} + \mu_{4t} - - - - - - - - - - - (11)$$

$$INT_t = \sum_{i=1}^{n} x_i LREM_{t-i} + \sum_{j=1}^{n} y_j LM2_{t-j} + \sum_{k=1}^{n} z_k LEXR_{t-k} + \sum_{l=1}^{n} m_l INF_{t-l} + \sum_{p=1}^{n} o_p INT_{t-p} + \mu_{5t} - - - - - - - - - - - (12)$$

Where it is assumed that μ_{1t}, μ_{2t}, μ_{3t}, μ_{4t}, and μ_{5t} are uncorrelated. The hypothesis of no causality between variables of interest is rejected if the F-statistic for the restricted and unrestricted residual sum of squares is significant at the conventional 1% or 5% level of significance. Since our interest is in testing for causality, one need not present the estimated coefficients of the above VAR model explicitly, just the results of the F-test (Gujarati and Porter, 2009).

4. Discussion of results

Unit root test

As noted earlier, the use of Johansen approach to co-integration requires that variables of interest are integrated of the same order, basically order one. Therefore, it is necessary to begin our analysis with diagnostic test for unit root. In this study, we employed the ADF and the PP unit root tests. The tests were carried out on levels and differences of the chosen variables and were performed assuming intercept and no trend in ADF and PP specifications. The results indicated that within the framework of ADF and PP unit root tests, all the variables are non-stationary at levels, but become stationary after their first differences. In other words, all the chosen variables are integrated of the same order, that is order one, I(1). This suggest the possibilities of long run relationship among LREM, LM2, LEXR, INF and INT (Table 1).

Table 1: ADF and PP Unit Root Results

Variable	ADF Stat.	Order of integration	PP Stat.	Order of integration
LREM	-3.673202***	I(1)	-7.482295***	I(1)
LM2	-2.824172*	I(1)	-3.553401**	I(1)
LEXR	-5.689606***	I(1)	-5.689606***	I(1)
INF	-3.232944**	I(1)	-3.450288**	I(1)
INT	-7.162448***	I(1)	-7.162448***	I(1)

NB: *, **, & * imply significant at 1%, 5%, & 10% levels of significance.**
Source: Authors' Computation using Eviews.

Co-integration test result

Determining the optimal lag length to be used in a co-integration analysis appears problematic. However, according to Brook (2003), the choice of information criterion used in resolving this problem is the author's since there is no criterion superior to the other. The information criteria used in this study are the Akaike Information Criterion (AIC) and the Schwarz Information Criterion (SIC). It is assumed that the lag length with the smallest value of AIC or SIC is the optimal one. Based on this, we found that the optimal lag length to be five. Although, the SIC is preferred when using small samples, the disagreement between it and AIC is settled using the Final Prediction Error (FPE) which in this case confirmed lag of five.

Table 2 presents the Johansen co-integration test results. The null hypothesis underlying this test is that $r = 0$, against the general alternatives that $r > 0$, 1, 2, 3, and 4. From the results, the null hypothesis of no co-integration among the variables is rejected at 5% level of significance since the values of both the trace statistic and the max-eigen statistic cannot reject the hypothesis that at most five co-integrating equations exist. This implies that there is long run relationship among remittances (LREM), exchange rate (LEXR), money supply (LM2), interest rate (INT), and inflation rate (INF) in Nigeria over the periods covered. Thus, using co-integration approach, we can safely conclude that there exist long run relationship among the variables. Evidence of co-integration is suggestive of causality at least one direction. To probe the case of causality in details, we applied the Ganger causality test.

Table 2: Johansen Co-integration Results

H_0	H_1	Trace Stat.	5% Critical value	Max-Eigen Stat.	5% Critical value
r = 0	r > 0	259.7752*	69.81889	94.86054*	33.87687
r ≤ 1	r > 1	166.9147*	47.85613	72.68026*	27.58434
r ≤ 2	r > 2	94.23443*	29.79707	60.74146*	21.13162
r ≤ 3	r > 3	33.49297*	15.49471	20.99586*	14.26460
r ≤ 4	r > 4	12.49711*	3.841466	12.49711*	3.841466

NB: * denotes rejection of the null hypothesis at the 0.05 level. Both trace test and max-eigen value test indicate 5 co-integrating equations at the 0.05 level.
Source: Authors' Computation using Eviews.

Ganger causality test results

The results from lag selection revealed the optimal lag length of five for AIC and one for the SIC. However, it should be noted that the Granger causality is sensitive to lags. Therefore, our research findings are guided by the optimal lags as we present the Granger causality results to cover from lag 1 to 5. The results of the Granger causality test (Table 3) from lag 1 to 5 indicated that unidirectional causality runs from money supply (LM2) to remittances (LREM) only at lag one and not in the reverse. For the other lags, there was no evidence of causality between them (LM2 and LREM). The results also showed that, consistently from lag one to lag five, causality runs from exchange rate (LEXR) to remittances (LREM) and not in reverse direction. This could be interpreted to mean that exchange rate is one of the major factors that determines inflows of remittances. We found evidence of unidirectional causality running from interest rate (INT) to remittances, occurring from lag one to lag four. However, there is no evidence of causality in any direction between inflation rate (INF) and remittances (LREM) within these lags. We also found that causality runs from exchange rate (LEXR) to money supply (LM2) only at lags one and four and there is no vice versa.

Further, there is evidence of unidirectional causality running from interest rate (INT) to money supply (LM2) only at lag one and there is no reverse causality between them. There is no causality between inflation rate (INF) and money supply (LM2) at any lag. Causality also run from exchange rate (LEXR) to interest rate (INT) starting from lag two to lag five and there is no vice versa. We as well found that causality run from exchange rate to inflation only at lag three and there is no vice versa. There is no causality between INF and INT, at lag one, but at lag two causality runs from INF to INT and from INT to INF at lag three while causality runs from INF to INT at lags four and five. The null hypothesis of no causality was therefore rejected at either 1% or 5% (Table 3).

Table 3: Granger causality test results

Null Hypothesis	Lag Order	F-Statistic (Prob.)	Remark
LM2 does not Granger-cause LREM LREM does not Granger-cause LM2	1	4.33956* (0.0438) 0.00078 (0.9779)	Rejected Accepted
LM2 does not Granger-cause LREM LREM does not Granger-cause LM2	2	2.28755 (0.1161) 0.30351 (0.7401)	Accepted Accepted
LM2 does not Granger-cause LREM LREM does not Granger-cause LM2	3	2.13532 (0.1145) 0.26331 (0.8513)	Accepted Accepted
LM2 does not Granger-cause LREM LREM does not Granger-cause LM2	4	1.83985 (0.1472) 1.35495 (0.2729)	Accepted Accepted
LM2 does not Granger-cause LREM LREM does not Granger-cause LM2	5	1.82980 (0.1406) 1.39239 (0.2585)	Accepted Accepted
LEXR does not Granger-cause LREM LREM does not Granger-cause LEXR	1	9.35194** (0.0040) 0.20697 (0.6517)	Rejected Accepted
LEXR does not Granger-cause LREM LREM does not Granger-cause LEXR	2	5.14228** (0.0109) 0.02294 (0.9773)	Rejected Accepted
LEXR does not Granger-cause LREM LREM does not Granger-cause LEXR	3	5.69317** (0.0030) 0.02949 (0.9930)	Rejected Accepted

LEXR does not Granger-cause LREM LREM does not Granger-cause LEXR	4	4.67017** (0.0047) 0.03070 (0.9930)	Rejected Accepted
LEXR does not Granger-cause LREM LREM does not Granger-cause LEXR	5	5.90748** (0.0008) 0.02393 (0.9997)	Rejected Accepted
INT does not Granger-cause LREM LREM does not Granger-cause INT	1	6.49315* (0.0149) 0.43113 (0.5153)	Rejected Accepted
INT does not Granger-cause LREM LREM does not Granger-cause INT	2	4.38750* (0.0197) 1.49252 (0.2384)	Rejected Accepted
INT does not Granger-cause LREM LREM does not Granger-cause INT	3	3.60636* (0.0234) 1.30845 (0.2881)	Rejected Accepted
INT does not Granger-cause LREM LREM does not Granger-cause INT	4	2.82774* (0.0421) 1.08709 (0.3806)	Rejected Accepted
INT does not Granger-cause LREM LREM does not Granger-cause INT	5	2.14822 (0.0900) 1.08306 (0.3920)	Accepted Accepted
INF does not Granger-cause LREM LREM does not Granger-cause INF	1	2.55003 (0.1184) 0.63988 (0.4286)	Accepted Accepted
INF does not Granger-cause LREM LREM does not Granger-cause INF	2	1.70871 (0.1955) 0.50545 (0.6075)	Accepted Accepted
INF does not Granger-cause LREM LREM does not Granger-cause INF	3	0.90175 (0.4507) 1.43797 (0.2494)	Accepted Accepted
INF does not Granger-cause LREM LREM does not Granger-cause INF	4	1.28697 (0.2972) 1.01847 (0.4136)	Accepted Accepted
INF does not Granger-cause LREM LREM does not Granger-cause INF	5	0.92575 (0.4797) 2.37591 (0.0655)	Accepted Accepted
LEXR does not Granger-cause LM2 LM2 does not Granger-cause LEXR	1	4.25692* (0.0458) 1.43707 (0.2378)	Rejected Accepted
LEXR does not Granger-cause LM2 LM2 does not Granger-cause LEXR	2	2.69897 (0.0809) 0.70584 (0.5004)	Accepted Accepted
LEXR does not Granger-cause LM2 LM2 does not Granger-cause LEXR	3	2.49657 (0.0769) 0.49890 (0.6856)	Accepted Accepted
LEXR does not Granger-cause LM2 LM2 does not Granger-cause LEXR	4	3.37613* (0.0214) 1.05139 (0.3975)	Rejected Accepted
LEXR does not Granger-cause LM2 LM2 does not Granger-cause LEXR	5	2.43252 (0.0606) 0.99266 (0.4407)	Accepted Accepted
INT does not Granger-cause LM2 LM2 does not Granger-cause INT	1	4.21735* (0.0468) 0.35251 (0.5561)	Rejected Accepted
INT does not Granger-cause LM2 LM2 does not Granger-cause INT	2	1.92848 (0.1601) 0.15443 (0.8575)	Accepted Accepted
INT does not Granger-cause LM2 LM2 does not Granger-cause INT	3	1.07881 (0.3715) 0.06015 (0.9803)	Accepted Accepted
INT does not Granger-cause LM2 LM2 does not Granger-cause INT	4	1.50186 (0.2266) 1.08227 (0.3828)	Accepted Accepted
INT does not Granger-cause LM2 LM2 does not Granger-cause INT	5	1.35209 (0.2732) 0.92499 (0.4801)	Accepted Accepted
INF does not Granger-cause LM2 LM2 does not Granger-cause INF	1	0.06462 (0.8007) 0.13489 (0.7154)	Accepted Accepted
INF does not Granger-cause LM2 LM2 does not Granger-cause INF	2	0.00607 (0.9940) 2.52994 (0.0937)	Accepted Accepted

INF does not Granger-cause LM2 LM2 does not Granger-cause INF	3	0.39813 (0.7552) 1.72129 (0.1817)	Accepted Accepted
INF does not Granger-cause LM2 LM2 does not Granger-cause INF	4	0.68506 (0.6079) 1.67252 (0.1823)	Accepted Accepted
INF does not Granger-cause LM2 LM2 does not Granger-cause INF	5	0.64566 (0.6671) 1.24476 (0.3161)	Accepted Accepted
INT does not Granger-cause LEXR LEXR does not Granger-cause INT	1	0.68317 (0.4135) 0.86272 (0.3587)	Accepted Accepted
INT does not Granger-cause LEXR LEXR does not Granger-cause INT	2	0.41861 (0.6611) 4.19746* (0.0230)	Accepted Rejected
INT does not Granger-cause LEXR LEXR does not Granger-cause INT	3	0.24012 (0.8677) 3.00105* (0.0444)	Accepted Rejected
INT does not Granger-cause LEXR LEXR does not Granger-cause INT	4	0.10341 (0.9804) 3.67427* (0.0150)	Accepted Rejected
INT does not Granger-cause LEXR LEXR does not Granger-cause INT	5	0.08776 (0.9936) 2.63954* (0.0456)	Accepted Rejected
INF does not Granger-cause LEXR LEXR does not Granger-cause INF	1	0.54123 (0.4663) 0.01135 (0.9157)	Accepted Accepted
INF does not Granger-cause LEXR LEXR does not Granger-cause INF	2	0.47885 (0.6234) 0.001120 (0.9889)	Accepted Accepted
INF does not Granger-cause LEXR LEXR does not Granger-cause INF	3	1.14012 (0.3473) 3.04263* (0.0425)	Accepted Rejected
INF does not Granger-cause LEXR LEXR does not Granger-cause INF	4	2.25674 (0.0864) 2.23981 (0.0883)	Accepted Accepted
INF does not Granger-cause LEXR LEXR does not Granger-cause INF	5	1.94129 (0.1203) 1.61920 (0.1888)	Accepted Accepted
INF does not Granger-cause INT INT does not Granger-cause INF	1	0.08688 (0.7697) 0.83406 (0.3667)	Accepted Accepted
INF does not Granger-cause INT INT does not Granger-cause INF	2	3.37096* (0.0455) 1.58530 (0.2189)	Rejected Accepted
INF does not Granger-cause INT INT does not Granger-cause INF	3	2.30983 (0.0944) 2.90159* (0.0495)	Accepted Rejected
INF does not Granger-cause INT INT does not Granger-cause INF	4	4.04719** (0.0097) 2.02257 (0.1165)	Rejected Accepted
INF does not Granger-cause INT INT does not Granger-cause INF	5	3.08113* (0.0251) 1.60718 (0.1920)	Rejected Accepted

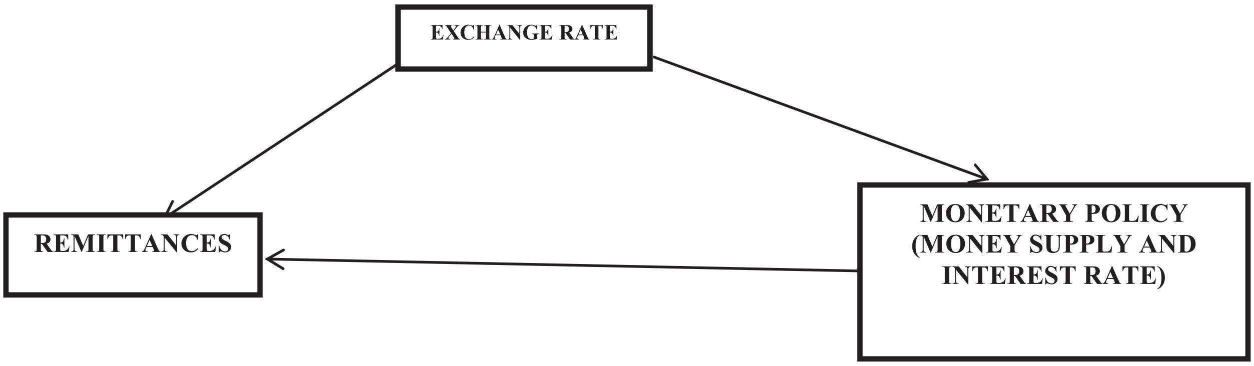
NB: **(*) denote rejection of the null hypothesis at 1%(5%) level; p-values in Parenthesis.
Source: Authors' Computation using Eviews.

5. Conclusions and policy recommendation

This paper examined the relationship and causality that exist between remittance inflows exchange rate and monetary aggregates - interest rate, and the domestic price level in Nigeria. The Johansen co-integration test indicated that long run relationship exist among the aforementioned variables. The Granger causality test results revealed a unidirectional causality running from money supply (LM2) to remittances (LREM) only at lag one and not in the reverse. For other lags, there was no evidence of causality between them (LM2 and LREM). The results also showed that, consistently from lag one to lag five, causality runs from exchange rate (LEXR) to remittances (LREM) and not in reverse direction. We found evidence of unidirectional causality running from interest rate (INT) to remittances, occurring from lag one to lag four. This result shows that to attract remittances inflows, INT appears to be one of the monetary policy variable to be tinkered with. However, there is no evidence of causality in any direction between inflation rate (INF) and remittances (LREM) within the lags. The independence in a way suggest that the government should treat them autonomously. We also found that causality runs from exchange rate (LEXR) to money supply (LM2) only at lags one and four and there is no vice versa.

In general, it can be deduced that within the five period-lags studied, exchange rate causes both remittances and monetary policy (money supply and interest rate) and there is no vice versa; monetary policy causes remittances and the reverse does not hold. This summary is aptly captured in Figure 1.

Figure 1: Flowchart summarizing the granger causality test results



Source: Authors' Initiative.

Note: Arrows indicate direction of causality.

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