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Remittance Volatility and Health Sector Performance: Evidence From Nigeria

Emmanuel Busuyi Oguntomi¹ and Sunday Osahon Igbinedion²

^{1,2}Department of Economics, University of Benin, P.M.B 1154, Benin City, Edo State, Nigeria,

¹eoguntomi@gmail.com, ²sunday.igbinedion@uniben.edu

Abstract: This study seeks to investigate the nexus between remittance volatility and life expectancy at birth within the Nigeria context. This study utilizes the ex-post facto research approach by seeking to ascertain the relationship between volatility in remittance and health sector performance within the framework of the Fully Modified Ordinary Squares (FMOLS) and Error Correction Model (ECM) for the period 1981 to 2018. Secondary data sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin and World Development Indicators (WDI) were utilized. Findings suggest that while remittance volatility has statistically significant negative impact on life expectancy in the long-run, it was however positive but insignificant in the short-run. Other factors such as income, education status and public health expenditure were also found to be major determinants of life expectancy in Nigeria. Given that remittances are largely susceptible to external shocks, and are beyond the control of policy makers in the recipient countries, relevant measures should be put in place in the home front to significantly cushion the negative impact of such fluctuations on life expectancy in the long-run.

Keywords: Remittance, Education, Volatility, Life Expectancy, Migration, Nigeria

Introduction

Migration has evolved as a global phenomenon since the past few decades, especially with globalization. Closely related with migration is remittance — the transfer of money by migrant workers to their country of origin. Essentially, the higher the level of migration, the higher the expected remittance arising from such migration in the future. However, there is a general view that remittances are mostly spent on consumption items and not used for productive investment that would have an impact on the long-run development of the economy. This view however ignores the fact that spending remittances on health is, in fact, investment in human capital.

In sub-Saharan Africa, remittances have grown significantly over the years, reaching \$32 billion, \$42 billion and \$48 billion in 2010, 2017 and 2019, respectively. The value of \$48 billion in 2019 represented about 0.5 percent decline over that of 2018 value, driven largely by the Corona Virus outbreak in those countries where African migrants reside. However, it is projected to further grow by 4 percent in 2020 (World Bank, 2020).

In Nigeria, the inflow of worker's remittances has experienced an upsurge in growth in the past three decades in absolute terms, though with some measure of variations. For instance, remittances inflow which stood at \$22 million in 1980 declined significantly to about \$4million in 1986 before attaining a peak of \$56 million in 1992. By the turn of the millennium however, remittances inflow stood at about \$1.39 billion, declined marginally to about \$1.06 billion before attaining a peak of about \$20.62 billion in 2011. By 2016, remittances inflow into Nigeria fell marginally to about \$19.68 billion, but by 2019, it stood at about \$23.8 billion (World Bank, 2020). From the foregoing trend analysis of remittances inflow into Nigeria in the past four decades, it is evident that, though the inflows have grown significantly, but such flows have been characterized by wide fluctuations, a development that may have severe consequences on the economic growth trajectory of the nation in general, and the life expectancy at birth of the citizens, given that a large chunk of remittances are expended on consumption (Glytsos,1993; Durand, Emilio & Douglas, 1996).

Furthermore, like the inflow of remittances into the economy, the life expectancy at birth in Nigeria has fluctuated remarkably over the last four decades. For instance, the average life expectancy at birth in Nigeria in 1981 was 45.33 years, but rose to about 46.10 years in 1985 before declining marginally to about 45.94 years in 1990. At the turn of the millennium, the average life expectancy in Nigeria stood at about 46.10 years but rose steadily thereafter to about 47.72, 50.39, 52.55, 53.49 and 54.81 years in 2005, 2010, 2015, 2017 and 2019, respectively (World Bank, 2020). Again, what become apparent from the foregoing trend analysis of life expectancy at birth in Nigeria is that, there have been remarkable variations, though since 2010, there has been an upward trend. Though, a number of factors have been identified in the health literature as probable causes of longevity in Nigeria, including socio-economic factors (see Bichak and Gutema, 2005; and Ohemeng, 2005), none appears to have recognized the impact of remittances received by household on longevity, let alone examining the likely impact of volatility in such variable. This study intends to fill this gap.

Specifically, the present study extends the current literature on the nexus between remittances and health sector performance in three significant ways. First, and to the best of the researcher's knowledge, no study within the Nigeria context has explicitly utilized household remittances as a determinant of health sector performance (the latter being proxied by life expectancy at birth) in Nigeria. Second, and more importantly, the study attempts to account for the fluctuations in such household remittances by utilizing the generalized autoregressive conditional heteroskedasticity (GARCH) approach, a procedure which models volatility as conditional on past behaviour (Bollerslev, 1986). Taking cognizance of the likely impact of such fluctuations in the estimation process will help produce results that will better inform policy making, especially, given the relative importance of remittances in health care financing in a developing nation like Nigeria. Thus, finding from this study will further reveal the importance of remittances inflow in health sector financing in general, and in promoting longevity in Nigeria in particular.

Third, the study utilizes the Fully Modified Ordinary Least Squares (FMOLS) estimation technique for the long-run estimates, and the Error Correction Model to account for the short-run dynamics.

Thus, the main purpose of this research work is to ascertain the likely impact of remittance volatility on health sector performance in Nigeria, given the relative growth in the volume of remittances (that is, relative to other external sources of finance available to the Nigerian economy) and the wide fluctuations that have accompanied such inflows of remittances over the years.

Literature Review

Conceptual/Theoretical Review

Remittances refer to a sum of money transfers made in form of payments or as gifts. Migrant's remittances therefore describe the value of monetary transfers or goods that migrants send back to families and friends in origin countries. Basically, remittances are the private savings of workers and families that are spent in the home country on items like food, clothing and other expenditure, and which drive the home economy. Following Serino, Neil and Kim (2011), remittances are often measured using three main variables viz: workers' remittances, employee compensation and migrant transfers. Compared to other forms of international resource inflows, remittances are considered more stable (Singh, 2006; Buch & Kuckulenz, 2010) and less vulnerable to external shocks given the altruistic component of such inflows.

Life expectancy at birth on the other hand, can be conceived as the average number of years a new-born child is expected to live given the prevailing age-specific mortality rates for that period. According to Organization for Economic Co-operation and Development (OECD) (2019), life expectancy describes how long, on average, a new-born is expected to live assuming the current death rates do not change. Life expectancy is commonly used to assess the health conditions prevailing in a country (Sharma, 2018). It is a major synthetic indicator for assessing both social and economic development of a country, be it developed, developing or emerging. Besides, life expectancy at birth provides the overall mortality pattern prevailing across all age cadres in a nation (World Health Organization, 2014).

In economic literature, several strands of theoretical models have been put forward to explain the motivation of migrants to remit. These models include the altruistic model, self-interest model, loan repayment model and the co-insurance model. In what follows, we briefly explain each of these models in turn.

Altruistic Model: Altruism motive is the most intuitive, tested and well known presumption where remittances are mainly used for supporting family consumption (food, clothing, etc). The altruism or livelihood school of thought considers remitting to be an obligation to the household. According to the altruistic model, sending remittances yields a satisfaction to the migrant out of a concern for the welfare of his family (Barham & Boucher, 1998).

Self-Interest Model: The self-interest motive posits that the migrant may remit for non-productive investments that may improve social position of family in home country. These include investing in assets holding such a land, farms, cattle or construction of residential buildings to enhance prestige, and increase influence in their social environment. In addition, migrants may remit when they intend to return to their home country or for inheritance back in their home country or buy services to maintain their assets (Chami, Fullenkamp & Jahjah, 2003).

Loan Repayment Model: In the loan repayment theory, the family invests in the education of the migrant and usually finances the costs of migrating (travel and subsistence costs in the host country). This is the loan (investment) element of the theory. The repayment part comes after the migrant settles in the foreign country and his income profile starts rising over time and is in a condition to start repaying the loan (principal and interests) back to the family in the form of remittances. This implicitly suggests that the family invests in a higher yield “asset” (the migrant) who earns a higher income level in the foreign country than other family members that live and work at home. The amount to be remitted will however, depend among other things, on the income profile of the migrant (Black, 2003; Addison, 2004).

Co-Insurance Model: This model is developed on the notion of risk diversification. According to Addison (2004), assuming that economic risks between the sending and foreign country are not positively correlated then it becomes a convenient strategy for the family as a whole, to send some to its members abroad (often the most educated) to diversify economic risks. The migrant, then, can help to support his family in bad times at home. Conversely, for the migrant, having a family in the home country is insurance as bad times can also occur in the foreign country. In this model, migration becomes a co-insurance strategy with remittances playing the role of an insurance claim.

Empirical Review

There has been an avalanche of studies linking remittances to human capital formation, majorly by way of improving access to education and health. In the context of health, most of such studies have focused on the impact of remittance on mortality rates, such as infant mortality, and have produced mixed results. However, there has been paucity of studies on the effect of remittances on life expectancy. For instance, studies such as Brockerhoff (1995) and Ssengonzi, De Jong and Stokes (2002) focused on the nexus between migration and childhood health. Specifically, Brockerhoff (1995) reported that, children from migrant mothers, at the initial stage, tend to have lower survival rates in urban centres than those children of non-migrant mothers. However, after two years of migrant’s residence in urban centres, the reverse becomes the case. In the study by Ssengonzi, De Jong and Stokes (2002), the results revealed that in the case of Uganda, children of urban non-migrant mothers have higher tendency to die compared to children of migrant mothers who reside in rural areas.

In a study conducted for rural Mexico, Hildebrandt and Mckenzie (2005) report that children from migrant households are less likely to die, compare to those from non-migrant households. According to them, this may not be unconnected with the fact that migration tends to enhance health knowledge and wealth status of migrants families communities of origin. Kanaiaupuni and Donato (1999), in their study of the effects of

migration on infant survival in Mexico recorded that, huge migration not accompanied by large inflow of remittances in sending communities brought about increase in infant mortality rate in those sending communities; however, as remittances increased, infant mortality rate declined in those sending areas. In another related study on Mexican municipalities, Lopez-Cordova (2006) observed that as the proportion of remittance-receiving household increased by 1 percent, infant death declined by about 1.2 lives, suggesting that remittances have a statistically significant negative impact on infant mortality in those Mexican municipalities.

Using panel and cross-country quintile-level data, Chauvet, Gubert and Mesple-Soms (2009) reported that remittances tend to reduce child mortality in those developing countries in their study. In another cross-country study on a sample of 69 low and middle-income counties, Zhunio, Vishwasrao and Chiang (2012) provided empirical evidence on the notable role of remittances in reducing infant mortality and raising the level of life expectancy at birth.

In a country-specific study, Naatus (2013) investigated the correlation between migrant remittances received by communities in El Salvador, and life expectancy and school retention, using the national household survey. The results reveal that, every one dollar amount of remittances received in those communities had a statistically significant positive relationship with life expectancy.

In Bangladesh, Pradhan and Khan (2015) examined the impact of remittance earning on the quality of life, with the later proxied by Human Development Index (HDI) and comprising three components, namely, income, education, and life expectancy. The result suggests that remittance has a significant positive impact on HDI and, by extension, on life expectancy.

Methodology

Data Source

The study utilized annual time series data covering 1981 to 2018. These data were sourced from the World Bank's World Development Indicators (WDI) and the Central Bank of Nigeria (various issues). The period (1981-2018) was chosen because of non-availability of reliable data for some of the variables of interest before 1981 and after 2018. We measure the volatility in remittances by utilizing the generalized autoregressive conditional heteroskedasticity (GARCH) procedure, given its high predictive power (Igbinedion, 2019). Following Bollerslev (1986), GARCH is a technique which models volatility as conditional on past behaviour. For this study, the best fitting time series GARCH (1,1) model was chosen based on the Akaike Information Criteria (AIC).

Model Specification

Based on the theoretical models and the empirical literature reviewed in section two, we hypothesize a simple model consisting of four covariates. Put differently, we model life expectancy at birth as a function of four independent variables, namely, GDP per capita, migrants' remittances received, public expenditure on health, and school enrollment (tertiary as percentage of gross) as follows:

$$LEXP_t - \alpha_0 + \Psi_1 MREM_t + \Psi_2 GDPPC_t + \Psi_3 PEXH_t + \Psi_4 TENR_t + \varepsilon_t \dots \dots \dots (1)$$

Where:

LEXP_t = Life expectancy at birth (a proxy for health sector performance)

MREM = Migrants’ remittances received

GDPPC = Gross domestic product per capita

PEXH = Public expenditure on health

TENR = School enrolment, tertiary (% gross)

ε_t = Error term (Gaussian white noise)

α₀, Ψ₁, Ψ₄ = Parameters to be estimated

α₀ > < 0; Ψ₁, Ψ₄ > 0

LN = Natural logarithm

Estimation Procedure

The data analysis techniques adopted in this study are the Fully Modified Ordinary Least Squares (FMOLS) and the Error Correction Modelling approaches. Also, applicable preliminary and post-estimation tests were also conducted for robustness purposes. And, following Asterious and Hall (2007) and Hyndman and Anthanasopolus (2013), we transform the variables using natural logarithm with a view to stabilizing the variance of the series.

The Fully Modified Ordinary Least Squares (FMOLS)

Essentially, the FMOLS is an optimal single equation estimation procedure which is based on the use of the Ordinary Least Squares (OLS). This approach provides semi-parametric correction for serial correlation and endogeneity (Phillips & Hansen, 1990). Thus, given the possibility of occurrence of long-run endogeneity in the variables as contained in equation 1, the study employed the FMOLS which helps to provide the long-run estimates for equation 1.

The Error Correction Model

In time series modelling, co-integrating regression can only provide the long-run property of the given model and not the short-run deviations. In a bid to overcome this shortcoming, Engle and Granger (1987) developed the error correction model (ECM). This procedure accounts for the short-run deviations that may have occurred in estimating the long-run cointegrating equation. This is accomplished by the introduction of the error correction term (ECT). The ECT provides the speed of convergence to equilibrium when the equation is perturbed. Thus, this study utilized this procedure for this purpose.

Findings

This section presents the descriptive properties of the data set utilized in this study as well as the results obtained from the various empirical evaluations for the period under consideration.

Figure 1 gives the graphical presentation of the data used for the estimation. From Fig 1, it can be observed that virtually all the variables exhibited moderate growth, that is, there were no wide fluctuations.

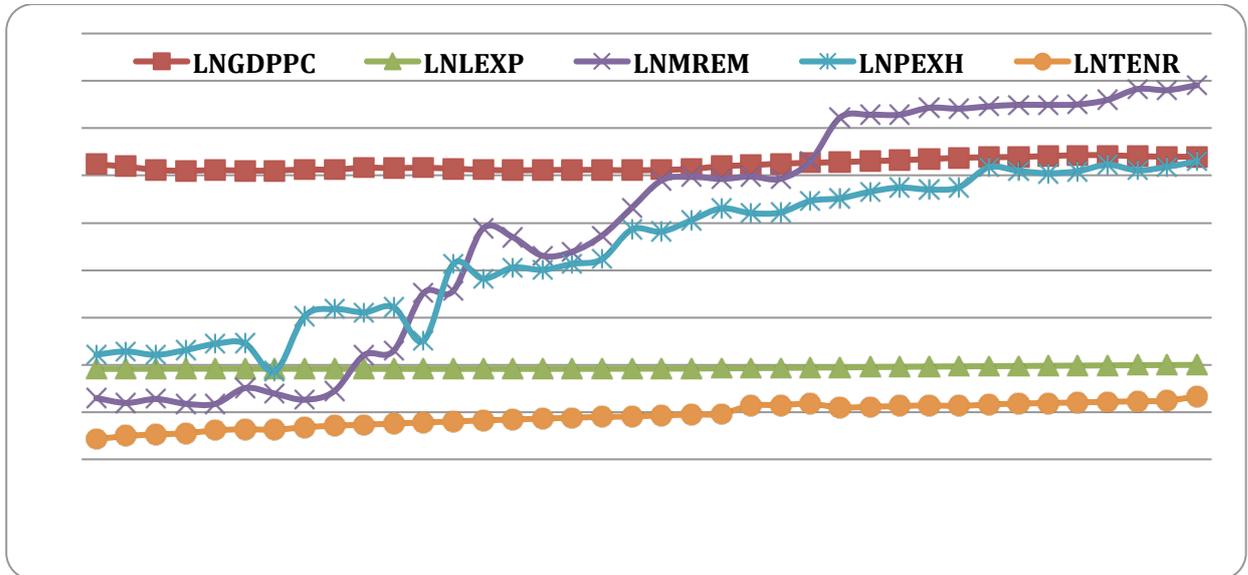


Figure 1. Graphical Representation of Data Used

Descriptive Statistics

The table below gives the descriptive statistics of the series utilized in the study. From the table, the mean values of GDPPC, LEXP, MREM, PEXH and TENR are 0.26, 48.11, 130299.0, 65104.78, and 7.13 respectively, while their median values are 0.24, 46.20, 87213.30, 15928.43, and 6.27 in that order. In addition, the standard deviation of GDPPC, LEXP, MREM, PEXH, and SENR are 0.06, 2.87, 2032710, 90048, and 3.26 respectively. Also, all the variables are positively skewed. Furthermore, while MREM and PEXH have excess kurtosis values, suggestive of a leptokurtic distribution, GDPPC, LEXP, and SENR are platykurtic in their behaviour. The Jarque-Bera test statistic suggests that only GDPPC and TENR variables are normally distributed since their p-values are each greater than 0.05.

Table 1. Descriptive Statistics

	GDPPC	LEXP	MREM	PEXH	SENR
Mean	0.26	48.11	130299.00	65104.78	7.13
Median	0.24	46.20	87213.30	15928.43	6.27
Maximum	0.39	54.30	7441124.00	296442.80	14.38
Minimum	0.20	45.64	10.45	41.31	2.33
Std. Dev.	0.06	2.87	2032710	90048	3.26
Skewness	0.70	0.93	1.53	1.23	0.27
Kurtosis	1.99	2.33	4.44	3.09	1.86
Jarque-Bera	4.74	6.22	18.06	9.65	2.53
Probability	0.09	0.04	0.00	0.01	0.28
Observations	38	38	38	38	38

Testing for Stationarity

Table 2. Unit Root Test Results: Augmented Dickey-Fuller Test Approach

Series	ADF Statistic	1% level	5% level	10% level	Order of Integration	Remark
LNGDPPC	-3.83	-3.63	-2.95	-2.61	I(1)	Stationary
LNLEXP	-4.19	-3.63	-2.95	-2.61	I(1)	Stationary
LNMREM	-5.92	-3.63	-2.95	-2.61	I(1)	Stationary
LNPEXH	-9.98	-3.63	-2.95	-2.61	I(1)	Stationary
LNTENR	-6.04	-3.63	-2.95	-2.61	I(1)	Stationary

Studies such as Granger and Newbold (1974) and Maddala and Wu (1999) have confirmed that most time series variables are non-stationary and, as such may generate spurious results. To overcome such pitfall, we investigated the stationarity status of the variables using the Augmented Dickey-Fuller (ADF) test. The results revealed that all the series are stationary at first difference, that is, I(1), again, validating the choice of our estimation procedure.

Testing for Co-integration

Table 3. Co-integration Test

Hypothesized No. of CE(s)	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	157.36	87.31	96.58
At most 1 **	82.79	62.99	70.05
At most 2	39.57	42.44	48.45
At most 3	15.89	25.32	30.45
At most 4	5.25	12.25	16.26
Hypothesized No. of CE(s)	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	74.57	37.52	42.36
At most 1 **	43.22	31.46	36.65
At most 2	23.68	25.54	30.34
At most 3	10.64	18.96	23.65
At most 4	5.25	12.25	16.26

** denotes rejection of the hypothesis at the 5%(1%) level

Trace test indicates 2 co-integrating equation(s) at both 5% and 1% levels

Max-eigenvalue test indicates 2co-integrating equation(s) at both 5% and 1% levels

According to Enders (1995), co-integration test is usually conducted to find out the presence or otherwise of a stable, long-run equilibrium relationship among the variables in a given model as this is important for policy making. To this end, two likelihood test ratios, namely, max-eigen, and trace tests were utilized to determine the number of co-integrating vectors. From the results as reported in table3, both max-eigen and trace tests indicate 2

co-integrating equations at both the 5% and 1% levels. This suggests the existence of a long-run relationship among the variables in the model.

Discussion of Findings

The Fully Modified Ordinary Least Squares (FMOLS) Estimates

Basically, the assessment of the impact of remittance volatility on health sector performance was accomplished using the Fully Modified Ordinary Least Squares procedure as contained in Table 4. Thus, while table 4 provides the long-run estimates, equation 2 gives the estimated long-run model as follows:

$$LNLEXP=1.3908-0.0079LNMREM-0.0025LNPEXH+0.1872LNGDPPC+0.1323LNTENR+\epsilon_t \dots\dots\dots (2)$$

The model as represented in equation (2) reveals that, holding all variables constant, LEXP becomes positive with a value of 1.3908 in the long-run. The results further reveals that while both MREM and PEXH are negatively related to LEXP, GDPPC, and TENR are positively related to LEXP, suggesting that a unit increase in both MREM and PEXH will bring about a decrease in LEXP, while a unit increase in GDPPC and TENR will produced a corresponding increase in LEXP. The inverse relationship between migrant’s remittances received and life expectancy though surprising, but can be explained away on two grounds. First, as more households receive more and more remittances, there is the tendency for them to participate less in labour-intensive activities (e.g. agriculture), but eat more, drink more, exercise less, and since more families can now afford cars, they tend to trek less. Second, with increase in migration over the years, the stress on families broken up by migration has risen significantly. This development has given rise to a situation where more children are being raised by older grandparents while their parents work abroad. Such shift of responsibility from parents to the elderly tends to place greater physical and emotional burden on the latter, with attendant negative effects on their health and life expectancy (Naatus, 2013). Also, the inverse relationship between life expectancy and public health expenditure may be partly explained by the fact that, the latter is a political variable capable of having heterogeneous impacts on health status (Rezapour, Mousavi, Lotfi, Movahed, and Alipour (2019) and partly because of the high level of corruption and fungibility associated with public health expenditure in many sub-Saharan African nations including Nigeria (Akinlo and Sulola, 2019). The result also reveals that while migrant’s remittances received (MREM), gross domestic product per capita (GDPPC), and school enrolment (TENR) are statistically significant at the 5% level, given that their p-values are less than 0.05 level of significance, while that of public expenditure on health (PEXH) was not significant given that its p-value is greater than 0.05 level of significance.

Table 4. Method: Fully Modified Least Squares (FMOLS)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNMREM	-0.0079	0.00	-2.71	0.01
LNPEXH	-0.0025	0.01	-0.46	0.65

LNGDPPC	0.1872	0.02	7.80	0.00
LNTENR	0.1323	0.03	4.43	0.00
C	1.3908	0.28	4.98	0.00
R-squared	0.87	Mean dependent var		3.87
Adjusted R-squared	0.86	S.D. dependent var		0.06
S.E. of regression	0.02	Sum squared resid		0.02
Long-run variance	0.00			

Normality Test

In a bid to further validate the robustness of our long-run estimates, we conducted the normality test as contained in figure2. From fig. 2, the error terms are normally distributed since the p-value of 0.0932 is greater than 0.05 level of significance. This implies that the estimated FMOLS model is robust.

Short-Run Analysis

To estimate the short-run model using the Error correction model, the first stage is to obtain the optimum lag for the model. This is done in table 5.

Table 5. VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	8.354607	NA	5.74e-07	-0.181330	0.036362	-0.104584
1	244.4907	395.6875*	6.44e-12*	-11.59409*	-10.28794*	-11.13361*

* 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

From Table 5, the VAR Lag selection criteria suggested optimal lag of 1. Thus, given that we are utilized the Error Correction Model (ECM), this suggests that the appropriate lag selection is 1, as indicated by LR, FPE, AIC, SC and HQ criterion.

Error Correction Estimates

Table 6. **ECM for Short Run Analysis**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.00028	0.00	-1.93	0.06
D(LNLEXP(-1))	0.95510	0.02	52.23	0.00
D(LNMREM)	0.00005	0.00	0.61	0.55
D(LNMREM(-1))	0.00034	0.00	9.55	0.00
D(LNPEXH)	0.00009	0.00	3.54	0.00
D(LNPEXH(-1))	0.00024	0.00	5.07	0.00
D(LNGDPPC)	0.00929	0.00	7.22	0.00
D(LNGDPPC(-1))	0.00354	0.00	4.13	0.00
D(LNTENR)	0.00168	0.00	3.27	0.00
D(LNTENR(-1))	0.00202	0.00	2.50	0.02
ECM(-1)	-0.01440	0.01	-2.28	0.03
R-squared	0.98	Mean dependent var		0.00
Adjusted R-squared	0.98	S.D. dependent var		0.00
S.E. of regression	0.00	Akaike info criterion		-11.46
Sum squared resid	0.00	Schwarz criterion		-10.98
Log likelihood	217.27	Hannan-Quinn criter.		-11.29
F-statistic	148.07	Durbin-Watson stat		0.43
Prob(F-statistic)	0.00	Wald F-statistic		1050.53
Prob(Wald F-statistic)	0.00			

Table 6 contains the parsimonious error correction estimates for life expectancy at birth (LEXP). From the table, the parameter of current value of migrants’ remittances received has a statistically insignificant positive relationship with life expectancy at birth in Nigeria. Specifically, the result indicates that a 1 percent change (rise) in migrants’ remittances received last year will still translate to about 0.00005 percent rise in life expectancy at birth on average. This suggests that temporal changes in remittances inflow may be offset by previous inflows, which may have been put into productive investment with significant returns to compensate any present decline in remittance inflow (Rahila, Maqbool, Ghulam, and Samina, 2011). In all, this result suggests that temporary shocks in remittances do not significantly impact on longevity in the short-run.

The coefficient of public expenditure on health was positive and statistically significant at 1 percent level of significance in its impact on life expectancy at birth in Nigeria. Specifically, this suggests that an increase in public health expenditure by 1 percent will cause life expectancy to rise by about 0.009 percent in Nigeria. This result is in line with those of Rajkumar and Swaroop (2008), Novignon, Olakojo and Navignon (2012), Jaba, Balam and Robu (2014) and Ranabhat, Atkinson, Park, and Jakovljevic (2018), but in contrast with those of Yaqub, Olapinwa, and Yussuff (2012) and Rahman, Khanam, and Rahman (2018) which confirmed insignificant impact of public health expenditure on health outcomes, probably due to the prevailing high level of corruption in those countries. This suggests the need for relevant legislations aimed at making public health expenditure a priority in budgetary allocations in order to further promote quality health outcomes, especially average life expectancy.

Similarly, gross domestic product per capita (GDPPC) was found to be positively associated with life expectancy at birth, as a 1 percent increase in GDPPC translates to

about 0.929 percent rise in life expectancy. This result implies that a 1 percent increase in per capita GDP will cause the average life expectancy at birth to rise by about 0.929. This finding is corroborated by those of Mpofu (2013) and Miladinov (2020), who separately observed that rise in the average income in a country positively impact on a nation’s level of longevity. This suggests the need for relevant policies aimed at boosting revenue base of the country with a view to raising the prevailing average income and, by extension, the life expectancy at birth of the citizenry.

Lastly, the coefficient of school enrollment, a measure of education status, was positive and statistically significant at 1 percent level of significance in its impact on life expectancy in Nigeria. This implies that education is an important determinant of life expectancy. This finding is in line with those of Sen (1999), Gulis (2000) and Umar (2017), but was found to be insignificant in the case of Ilori, Olalere, and Adeleye (2017). Essentially, education affects life expectancy both directly and indirectly. Directly, education helps to improve the health awareness of the citizens, thereby promoting life expectancy. Education indirectly impact the life expectancy of the people by raising their income level and attainments for female and, by implication, the health of children. This finding, like that on public health expenditure, calls for the need to prioritize budgetary allocations to human capital development with a view to promoting longevity in the country.

Residuals and Stability Diagnostics

As part of robustness checks, we conducted multicollinearity, heteroskedasticity, and normality tests using the Variance Inflation Factor, Breusch Pagan-Godfrey, and the Jarque-Bera Statistic respectively. From table 7, the centered variance inflation factor (VIF) for the variables are less than 10 (i.e, VIF <10), suggesting the absence of multicollinearity among the variables in the FMOLS model estimated.

Table 7. Variance Inflation Factor

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	7.50E-08	8.053106	NA
D(LNLEXP(-1))	0.000709	3.176730	1.530992
D(LNMREM)	3.31E-08	2.408175	1.912696
D(LNMREM(-1))	2.48E-08	1.804394	1.456117
D(LNPEXH)	2.37E-08	1.684966	1.558006
D(LNPEXH(-1))	2.82E-08	1.999440	1.852293
D(LNGDPPC)	7.41E-06	1.676704	1.570735
D(LNGDPPC(-1))	9.59E-06	2.436524	2.352181
D(LNTENR)	2.46E-06	1.884465	1.309410

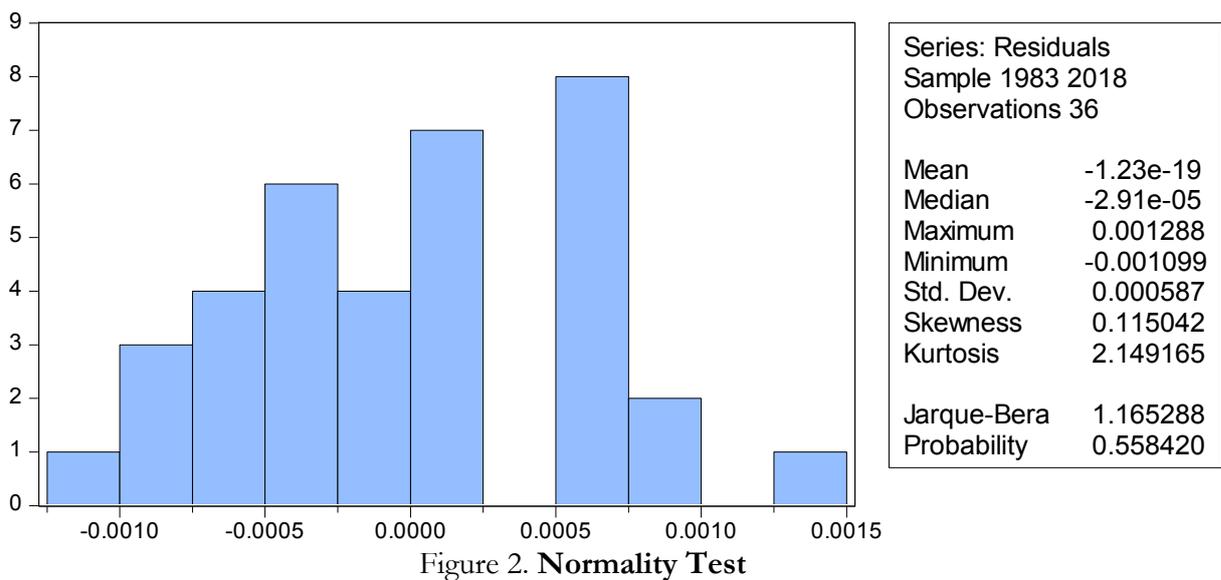
D(LNTENR(-1))	2.64E-06	1.901196	1.318164
ECM(-1)	0.000101	2.283269	2.282915

Similarly, table 8 gives the outcome of the heteroskedasticity test that was carried out on the model. The result reveals that the variance of the residuals are constant, since the (p-value = 0.678870.05). This suggests absence of heteroskedasticity in the residual.

Table 8. **Heteroskedasticity Test: Breusch-Pagan-Godfrey**

F-statistic	0.742977	Prob. F(10,25)	0.6788
Obs*R-squared	8.247725	Prob. Chi-Square(10)	0.6047
Scaled explained SS	2.285397	Prob. Chi-Square(10)	0.9936

Furthermore, Figure 2 gives the normality test result. From the figure, the error terms are normally distributed since the p-value of 0.55642 is greater than the 0.05 level of significance. This implies that the estimated ECM model is robust.



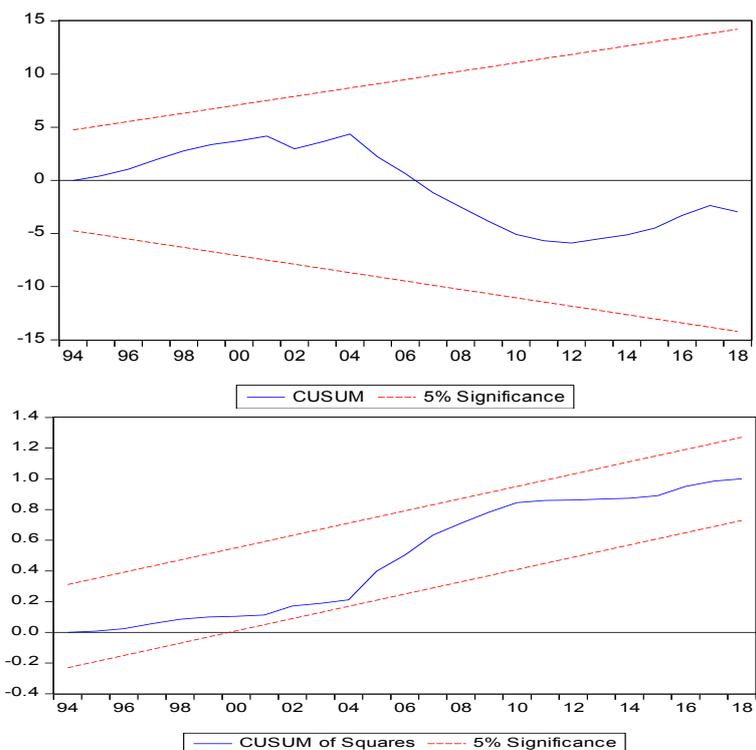


Figure 3. Parameters Stability Test

Also, as part of our stability test, the stability properties of the error correction estimates were evaluated using the graphs of the cumulative sum of Recursive Residual (CUSUM) and the Cumulative Sum of Squares of Recursive Residual (CUSUMSq). Following Brown, Durbin and Evans (1975), the results indicate the absence of any instability of the coefficients because the plots of the CUSUM and CUSUMSq fall within the critical bands of the 5 percent confidence interval of parameter stability. This further confirms that the model is good for forecasting.

Pairwise Granger Causality Test

In a bid to further validate our short-run estimates, we conducted the Pairwise Granger Causality tests as reported in Table 9. From the table, migrant’s remittances received, public expenditure on health, GDP per capita as well as tertiary enrollment all granger cause life expectancy at birth in Nigeria. This further lends credence to the results obtained in the ECM and FMOLS models.

Table 9. **Pairwise Granger Causality Tests**

Sample: 1981 2018

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LNLEXP does not Granger Cause LNGDPPC	36	6.53	0.00
LNGDPPC does not Granger Cause LNLEXP		7.89	0.00
LNMREM does not Granger Cause LNGDPPC	36	3.64	0.04
LNGDPPC does not Granger Cause LNMREM		0.01	0.99

LNPEXH does not Granger Cause LNGDPPC		4.09	0.03
LNGDPPC does not Granger Cause LNPEXH	36	0.91	0.41
LNTENR does not Granger Cause LNGDPPC		3.52	0.04
LNGDPPC does not Granger Cause LNTENR	36	1.28	0.29
LNMREM does not Granger Cause LNLEXP		20.58	0.00
LNLEXP does not Granger Cause LNMREM	36	0.24	0.79
LNPEXH does not Granger Cause LNLEXP		43.54	0.00
LNLEXP does not Granger Cause LNPEXH	36	0.16	0.85
LNTENR does not Granger Cause LNLEXP		39.48	0.00
LNLEXP does not Granger Cause LNTENR	36	0.25	0.78
LNPEXH does not Granger Cause LNMREM		9.02	0.00
LNMREM does not Granger Cause LNPEXH	36	5.75	0.01
LNTENR does not Granger Cause LNMREM		3.68	0.04
LNMREM does not Granger Cause LNTENR	36	2.14	0.14
LNTENR does not Granger Cause LNPEXH		2.72	0.08
LNPEXH does not Granger Cause LNTENR	36	1.98	0.16

Conclusion

Over the years, remittances have grown rapidly, especially in developing countries. In Nigeria, the scale and the potential impacts of these flows have necessitated researches, especially as it impinges on health outcomes. While an avalanche of such studies exist on the impact of such flows on health outcomes at both the microeconomic and macroeconomic levels, the literature appears to have been largely mute on the potential effects of remittance volatility on health outcomes, especially life expectancy at birth. This study proposes to investigate this nexus between remittance volatility and life expectancy with a view to providing relevant guide to policy making.

The study utilized both the FMOLS and the ECM models to investigate the nexus between remittance volatility and life expectancy in both the short-run and long-run. Estimates from the long-run model revealed that fluctuations in remittances have a statistically significant (negative) impact on life expectancy at birth in Nigeria.

Also, the impact of per capita GDP and school enrolment (a proxy for education status) were found to be statistically significant in both FMOLS and ECM models, while that of public expenditure on health was only significant in the short-run, a development that may not be unconnected with the persistently low level of public health expenditure as a percentage of the GDP over the years, relative to agreed international standards.

In view of the foregoing findings, we proffer the following policy recommendations. First, given the fact that remittances are largely susceptible to external factors such as shocks in migrants' host countries, the ability of policy makers in the home countries to fully stabilize remittances becomes minimal. In this regard, efforts should be geared towards broadening the nation's revenue base with a view to cushioning the likely negative consequences of such fluctuations in remittances on the average life expectancy.

Such enhanced revenue base will also go a long way in raising the prevailing average income level as well promoting human capital development, especially if accompanied by prioritization of budgetary allocations to health and education sectors in the country. Such efforts should be complemented by putting in place relevant measures aimed at ensuring efficient managements of allocated funds to those priority sectors as well as carrying out periodic evaluation of the impact of such allocations on those priority sectors.

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