DETERMINANTS OF INTERNATIONAL AIR PASSENGER TRAVEL DEMAND IN NIGERIA: COINTEGRATION AND CAUSALITY ANALYSIS

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ABSTRACT

This paper examines the determinants of international air passenger travel demand in Nigeria using annual data from 1982 to 2019. Autoregressive distributed lag approach was employed to analyse short- and long-run relationships between the variables while Granger causality test was conducted to determine the direction of causality. Total real trade and economic growth are major factors positively influencing air travel demand in the short- and long-run. Contrary to findings in the literature, foreign direct investment impact air travel negatively in the long-run but has a positive effect in the short-run with 1-3year lag. Real exchange rate is found to reduce air travel demand in the short-run. The results indicate a bidirectional Granger causality between air travel and total real trade, and between air travel and economic growth. Infrastructure that will support increase in demand for international air passenger travel due to economic growth are required.

KEYWORDS

international air passenger traffic; demand; cointegration analysis; causality analysis; macroeconomic factors; Nigeria

1. INTRODUCTION

International air travel demand in Nigeria has witnessed significant growth in recent years. According to the annual reports of Federal Airport Authority of Nigeria-FAAN (FAAN 2019), enplaned international air passengers to and from Nigeria increased by 286% from 1.1 million in 1982 to 4.6 million in 2019 (figure 1). This growth has been attributed to the liberalization of the air transport market (Oluwakoya 2011). With the adoption of deregulation, privatization and liberalization policies, Nigeria signed open skies agreement with the United States, Bilateral Air Service Agreement (BASA) with several countries and implemented the Yamoussoukro Declaration with the aim of increasing international air traffic to and from Nigeria. In addition, the aviation agencies have made huge investments on infrastructures in the airports. In spite of these efforts, the volume of international air traffic in Nigeria is low compared to other countries in Africa such as Ethiopia, Kenya, Egypt, South Africa, and Morocco ((ICAO 2018). It is important to determine other factors influencing international air passenger traffic besides air service agreements so as to implement policies that will increase demand and enhance economic growth in the future.

Several studies in the literature have examined the factors influencing demand for international air travel (Abed, Ba-Fail, Jasimuddin 2001; Kulendran and Wilson 2000; Chi 2020; Chang 2012: Pacheco and Fernandes, 2017; Zhang 2015; Chi, 2014; Seetaram, 2012; Zhang, Qu, Tavitiyaman 2009; Pham, Nghiem, Dwyer 2017; Eita, Jordaan and Jordaan 2011; Naude and Saayman, 2005; Deese, 2013). Most of these studies focused on the US, countries in the Asia-Pacific region including Australia, Thailand, South Korea with very few on African countries particularly Nigeria. These countries have high traffic and matured aviation markets. Furthermore, while the long-run effects of determinants of international air travel demand have been examined in previous studies (Webber, 2001; Kulendra and Wilson, 2000), analysis of the simultaneous effects of the short- and long-run dynamics of these factors have attracted little attention (Chi, 2014). Since the long-run adjustment of air travel demand to macroeconomic factors could be different from its short-run effect, estimating the short- and long-run dynamics in a single model is essential (Chi, 2014).

The objective of this paper is to examine the impact of total real trade-sum of real export and real import, real gross domestic product (constant 2015 US$), real effective exchange rate index (2010=100), and net inflows foreign direct investment on international air passenger travel demand in Nigeria. Bounds testing approach to cointegration within an autoregressive distributed lag (ARDL) framework proposed by

Pesaran, Shin and Smith (2001) was applied. In addition, Granger causality test was employed to examine the causal relationship between the macroeconomic factors and demand for international air travel. Annual data over the period 1982-2019 was used for the analysis. This study is important because understanding the causal relationships will guide economic decisions made by airlines, airports, policymakers, government agencies and other stakeholders. Analysis of the short and long-run impacts of factors influencing international air passenger traffic could influence decisions on airplane design, production planning, airspace and infrastructure planning, planning of airline's route choice, pricing and revenue management, forecasting and supply chain management, reduce risk on investments, improve efficiency of the aviation industry, and design of appropriate policies and regulations by the government (Fernandes and Pacheco 2010; Hakim and Merkert 2019).Furthermore, the determinants of international air travel demand could be different in a low income country with low demand for air travel compared with countries with high income.

2. LITERATURE REVIEW

Several studies in the literature have used various economic, locational, structural, service-related measures and public policy indicators to investigate the determinants of international air passenger travel demand. Using system generalized method of moments approach, Zhang (2015) found that aviation policy, gross domestic product (GDP), bilateral merchandise trade, distance, common language and immigration are determinants of international arrivals to Australia. Vijver, Derudder, Witlox (2014) applied heterogeneous time series cross section Granger causality analysis to investigate the linkages between trade and air passenger traffic among different country pairs in Asia-Pacific region. Findings revealed significant causality running from air passenger to trade between more developed and less developed countries and causality running from trade to air passenger for countries with liberalized air transport policies. Results of regression analysis of determinants of international air travel demand in Saudi Arabia by Abed, Ba-Fail, Jasimuddin (2001) indicate that population size, and total expenditure are significant factors influencing air travel demand. Kulendran and Wilson (2000) employed cointegration and Granger causality approaches to investigate the relationship between international trade and travel flows between Australia and USA, the UK, New Zealand and Japan. The authors concluded that there is causal relationship between travel and total real trade (sum of real export and import).

The determinants of bilateral air passenger flows between pairs of ASEAN countries was examined by Chang (2012). Data on population, GDP, annual import/export, national income per capita, unemployment rate, consumer price index, distance and language for each country for 2006 and 2007 was analysed using linear regression and non-parametric regression tree methods. All the explanatory variables except population significantly influenced passenger flows. The relationship between air traffic volume and 35 macroeconomic indicators in Taiwan was analysed by Chen et al. (2020) using K-means clustering and decision tree classification. The major determinant of air traffic are industrial production index, national income per capita, employed population and Japanese stock average.

Zhang, Qu, Tavitiyaman (2009) used annual times series data to investigate determinants of international tourist arrivals to Thailand. Results of multiple regression analysis showed that exchange rate, promotion budget, Asia financial crisis and SARS were significantly associated with international air travel demand. Deese (2013) found that income, relative prices, cultural factors (being from an English-speaking or a bordering country) and policy are major determinants of inbound travel to the US. Pham, Nghiem, Dwyer (2017) examined determinants of inbound travel from China to Australia using a dynamic time series estimator. Findings showed that gross domestic product (GDP) per capita and weighted price are significant factors influencing travel demand.

Lee (2012) examined the long-run and Granger causal relationship between foreign exchange rates and inbound and outbound travel demand in South Korea. Increase in exchange rate reduces outbound travel demand from Korea but does not change inbound travel demand from other countries. Naude and Saayman (2005) used panel data for the period 1996 to 2000 to identify the determinants of inbound travel to 43 African countries. The paper concluded that political stability, tourism infrastructure, marketing, information and level of development are the determinants of travel to Africa. In South Africa, income, exchange rate and infrastructural development have significant impact on inbound travel (Eita, Jordaan and Jordaan 2011). Long-run demand for international travel from Australia during the period 1983 to 1997 was examined by Webber 2001 using Granger causality approach. Results showed that changes in exchange rate influence destination choice and national income is the most important determinant of travel. Jena and Dash (2020) employed quintile regression to investigate the impact of GDP per capita, nominal Indian Rupee US Dollar exchange rate and exchange rate volatility on inbound travel into India. It was found that per capita income and exchange rate volatility have strong impact on international arrivals. Similar findings

were reported by Agiomirgianakis, Serenis, Tsounis, (2014) in Turkey. While GDP per capita has a positive effect on international arrivals into Turkey, exchange rate volatility exerts a negative influence on travel.

Although determinants of international air travel have been examined extensively, analysis of the short and long-run impact of macroeconomic factors on travel have attracted little attention. Pacheco and Fernandes (2017) applied Granger causality framework to investigate the determinants of international air passenger traffic in Brazil. Results showed that international trade openness and US$ purchasing power have significant short- and long-run effects on international air travel demand. Chi (2014) examined the short- and long-run impact of GDP, exchange rate and 9/11 terrorist attack on demand for international air travel to and from the USA using ARDL approach. Findings revealed that GDP has a strong effect on demand for inbound and outbound travel from the US while real bilateral exchange rate has mixed effects. Also, a unidirectional Granger causality running from GDP and exchange rate to bilateral air flows was reported. In another study, Chi (2020) revealed that real income has a significant effect on outbound travel demand from South Korea to all the selected countries both in the short- and long-run.

A cursory look at the studies reviewed indicate that determinants of international air travel demand is not conclusive because different determinants, analytical techniques, and types of travellers are used to examine international travel demand in countries with different degree of market maturity. Hence, the results are different (Valdes, 2015). However, the literature is in agreement that macroeconomic factors influence international air travel demand. Our paper aims to examine the short- and long-run effects of macroeconomic factors on international air travel demand in a developing country (Nigeria) using ARDL cointegration and Granger causality approaches.

3. MATERIALS AND METHODS

Annual data over the 38-year period between 1982 and 2019 was used for the empirical analysis. The data is limited to 2019 since air travel was restricted in 2020 due to coronavirus pandemic which affected many countries. Data on total number of enplaned air passengers' movements (arrivals and departures) was used as an indicator of international air travel demand (PAX). Data on air passengers was obtained from annual reports of Federal Airport Authority of Nigeria (FAAN 1982-2019). The FAAN collates

data on air passenger from all the airports in the country. The explanatory variables are total real trade-sum of real export and real import (TRA), real gross domestic product (constant 2015 US$) (GDP), real effective exchange rate index (2010=100) (REX), and net inflows foreign direct investment (FDI). Total real trade is an indicator of international trade while real GDP is a proxy for economic growth. Real exchange rate is used as a proxy for cost of travel and tourism for international arrivals into Nigeria. In addition, net inflows of FDI is a proxy for international traffic drivers (Valdes 2015). The World Development Indicators was the source of data on real trade, real GDP, real effective exchange rate index and net FDI similar to Valdes (2015). All the variables were converted to natural logarithms. Table 1 shows the descriptive statistics of variables used in the analysis.

The effect of macroeconomic factors on international air passenger travel demand in Nigeria is examined using econometric approaches for testing cointegration and causality. A three-stage procedure was adopted to determine the direction of causality. First, unit root test is conducted to determine the stationarity and order of integration of the series. Second, the existence of a long-run relationship (cointegration) among the variables when international air travel demand (PAX) is the dependent variable is investigated using the ARDL approach. The ARDL cointegration approach proposed by Pesaran, Shin and Smith (2001) has some advantages compared to other cointegration techniques (Engle and Granger 1987). Compared with the Johansen technique which require the variables to be integrated of the same order I(1) or I(0), the ARDL approach can be applied irrespective of the order of integration of the variables whether I(0), I(1) or both. The ARDL approach perform better for small and finite sample size (Chi 2016). Furthermore, the optimal number of lags of each variable could be different. The long-run and short-run parameters of a model are estimated simultaneously and endogeneity problems are avoided. The result of the ARDL analysis determines the causality test that will be employed. If the series are cointegrated, vector error correction model (VECM) is estimated to determine the direction of causality in the series. However, if the series are not cointegrated, the standard Granger causality test (vector autoregression-VAR) is applied. Eviews 10 software was used to conduct the empirical analysis.

Table 1. Descriptive statistics of variables

	PAX	IMEX	GDP	REX	FDI
Mean	2153624.	9.50E+10	2.56E+11	144.2260	2.57E+09
Median	1484861.	8.59E+10	1.83E+11	100.2585	1.61E+09
Maximum	4673797.	2.03E+11	5.03E+11	536.8903	8.84E+09

Minimum	812621.0	3.43E+10	1.13E+11	49.74471	1.89E+08
Std. Dev.	1380562.	4.52E+10	1.36E+11	116.7392	2.61E+09
Skewness	0.728799	0.645513	0.663236	2.042306	1.113498
Kurtosis	1.931442	2.518499	1.879080	6.384059	2.985864
Jarque-Bera	5.171810	3.006105	4.775317	44.54853	7.852883
Probability	0.075328	0.222450	0.091845	0.000000	0.019714
Sum	81837702	3.61E+12	9.75E+12	5480.589	9.76E+10
Sum Sq. Dev.	7.05E+13	7.57E+22	6.86E+23	504237.4	2.53E+20
Observations	38	38	38	38	38

3.1 UNIT ROOT TEST

The order of integration and stationarity of the time-series data was examined to ensure that none of the variables was integrated of order two, $I(2)$ and higher. If the variables are $I(2)$, the F-statistics will not be valid (Ouattara, 2004). A stationary series revert to its long-run average and its statistical properties (mean, variance and co-variance) do not change overtime. Non-stationary series do not revert to its long-run average value so the statistical properties change overtime (Shrestha and Bhatta, 2018). A non-stationary series is transformed by first differencing d times to make it stationary, then the series is integrated of order d, $I(d)$. Dickey-Fuller generalized least squares (DF-GLS) method was used to conduct the unit root test of the variables. The DF-GLS test has better performance in terms of small sample size and power when an unknown mean or trend is present (Elliot et al., 1996). Since our sample covers a period of 38years, the DF-GLS unit root test was considered appropriate. The DF-GLS unit root test takes the following form:

$$\Delta Y^{d}_{t} = \alpha Y^{d}\, t\text{-}1 + \sum_{i=1}^{k} \psi_i \Delta\, Y^{d}_{\,t\text{-}i} + u_t \qquad (1)$$

where Δ is the difference operator, t represents the period, k is the lag order and u_t is the error term. The series for the variables (Yt) is detrended to $Y^{d}t$ (the series is regressed on a constant and linear trend, and the residual series is used in a standard Dickey-Fuller regression) and $\Delta Y^{d}t$ represent the first difference of the detrended series with no intercepts or time series trend. The DF-GLS follows a D-F distribution in the constant case but the asymptotic distribution is different when constant and trend are included. The DF-GLS test the null hypothesis that each of the variables have a unit root, Yt =I(1) Ho: $\phi = 1$ against the alternative hypothesis: H_1: series is stationary, $\phi < 1$. When the probability value of the DF-GLS statistic is less than 0.05, the statistics is greater than the critical value in absolute terms and Ho is rejected. This implies that the series is stationary. The lag length was based on Schwarz Bayesian Criterion.

3.2 CONINTEGRATION

The existence of a long-run equilibrium relationship among the series was examined using ARDL approach to determine if the time series data are cointegrated. Following Chi (2014), the log-linear form of demand for international air travel is specified as:

$$\text{In } PAX_t = a_0 + a_1 InTRA_t + a_2 \text{In } GDP_t + a_3 InREX_t + a_4 \text{ InFDI}_t + \varepsilon_t \quad (2)$$

where In PAX is the log of the number of enplaned passengers (arrival and departure from Nigeria), In TRA is the log of merchandise trade, In GDP represent the log of real gross domestic product per capita (constant 2015 US$), In REX is the log of real effective exchange rate index (2010=100), InFDI is the log of net foreign direct investment and t represent time. In terms of the signs of the coefficients, it is assumed that $a_1 > 0$ since an increase in trade can lead to rise in international travel. Similarly, improvement in national income could also increase the demand for international travel for business and holiday, hence a_2 is expected to be positive. Increase in real exchange rate reduce the demand for inbound travel as the cost of international travel to Nigeria increases. On the other hand, the increase in real effective exchange rate reduce the cost of outbound travel from Nigeria and travel demand increases. Hence, it is assumed that $a_3 > 0$. Findings in the literature indicate that increase in FDI leads to increase in air travel demand. Hence, a4 is expected to be positive, i.e. $a_4 > 0$. The ARDL representation of equation (2) is as follows:

$$\Delta \text{ In } PAX_t = b_0 + \sum_{i=1}^{k} b_1 i \, \Delta \text{InPAX}_{t-i} + \sum_{i=1}^{k} b_2 i \Delta \text{InTRA}_{t-i} + \sum_{i=1}^{k} b_{3i} \Delta \text{In GDP}_{t-i} + \sum_{i=1}^{k} b_{4i} \Delta \text{In REX}_{t-i}$$

$$+ \quad b_5 \text{InFDI}_{t-i} + b_6 \text{InTRA}_{t-i} + b_7 \text{InGDP}_{t-i} + b_8 \text{InREX}_{t-I} + b_9 \text{InFDI}_{t-I} + \varepsilon_t \quad (3)$$

where Δ is the first difference operator, k is the lag order, the coefficients of the lagged level terms (b_5, b_6, b_7, b_8, b_9) indicate the long-run relationships among the variables while b_1, b_2, b_3, b_4 and b_5 represent the short-run dynamics. In the bound testing approach to cointegration, the existence of a long-run equilibrium relationship among the variables is determined using F-statistic. The F-statistic test the significance of the lagged levels of the variables. F-statistic is a joint significance test of the null hypothesis of no cointegration among the variables (H_0: $b_5 = b_6 = b_7 = b_8 = b_9 = 0$) against the alternative hypothesis (H_1: $b_5 \neq b_6 \neq b_7 \neq b_8 \neq b_9 \neq 0$). The F test has a non-standard distribution and two sets of critical values are computed (upper and lower bound critical values) for a specific significance level. The critical value provides bounds for regressors

that are purely $I(1)$ and purely $I(0)$. If the computed F-statistic is higher that the upper critical bounds, the variables are cointegrated and H_0 is rejected. If the computed F-statistic is lower than the lower bound of the critical value, the variables are not cointegrated and the null hypothesis cannot be rejected. If the estimated F-statistic falls inside the two critical bounds, then the result is inconclusive. When a long-run relationship is confirmed among the variables, the error correction model is derived from the ARDl model in equation 3 through a simple linear transformation given as:

$$\Delta InPAX_t = c_0 + \sum_{i=1}^{k} c_{1i}\Delta InPAX_{t-i} + \sum_{i=1}^{k} c_{2i}\Delta TRAt\text{-}i + \sum_{i=1}^{k} c_{3i}\Delta InGDP_{t-i} + \sum_{i=1}^{k} c_{4i}\Delta InREX + \sum_{i=1}^{k} c_{5i}\Delta InFDI +$$

$$\lambda ECT_{t-1} + \varepsilon_t \qquad (4)$$

where λ, the coefficient of the error correction term (ECT) is the speed of adjustment. The ECT in equation (4) integrates the short-run dynamics and the long-run equilibrium to avoid spurious relationship due to non-stationary time series data (Shrestha and Bhatta, 2018). The existence of a long-run equilibrium relationship among variables is confirmed if the coefficient of the error-correction term is negative, range between 0 and 1 and is statistically significant.

3.3 GRANGER CAUSALITY

The Granger causality test is used to examine causal relationship between international air passenger traffic and the macroeconomic variables. According to Granger (1988), if there is a cointegrating relationship among variables, then there is a Granger causality in at least one direction provided the variables are integrated of the order one. The lagged ECT is added to the standard Granger causality test (VAR) if the variables are cointegrated. Otherwise, the Granger causality test will be unspecified (Engle and Granger, 1987). The VECM differentiates between the long-run and short-run relationship among the variables and identify the source of causation. Through the VECM, the long-run causal relationship is determined based on the ECT. Following the work of Narayan and Smyth (2004), the Granger causality test which includes the ECT is specified in a multivariate pth order VECM as follows:

$$\begin{bmatrix} \Delta \text{In PAX} \\ \Delta \text{In TRA} \\ \Delta \text{In GDP} \\ \Delta \text{In REX} \\ \Delta \text{In FDI} \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \\ c_3 \\ c_4 \\ c_5 \end{bmatrix} + \sum_{i=1}^{k} \begin{bmatrix} d_{11i} & d_{12i} & d_{13i} & d_{14i} & d_{15i} \\ d_{21i} & d_{22i} & d_{23i} & d_{24i} & d_{25i} \\ d_{31i} & d_{32i} & d_{33i} & d_{34i} & d_{35i} \\ d_{41i} & d_{42i} & d_{43i} & d_{44i} & d_{45i} \\ d_{51i} & d_{52i} & d_{53i} & d_{54i} & d_{55i} \end{bmatrix} \begin{bmatrix} \Delta \text{In PAX}_{t-i} \\ \Delta \text{In TRA}_{t-i} \\ \Delta \text{In GDP}_{t-i} \\ \Delta \text{In REX}_{t-i} \\ \Delta \text{In FDI}_{t-i} \end{bmatrix} + \begin{bmatrix} \lambda 1 \\ \lambda 2 \\ \lambda 3 \\ \lambda 4 \\ \lambda 5 \end{bmatrix} [ECT_{t-1}] + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \end{bmatrix} \qquad (5)$$

EC_{t-1} is the lagged ECT obtained from the long-run relationship but it is not included if the variables are not cointegrated, and ε_1, ε_2, ε_3, ε_4 and ε_5 are random errors. Standard Chi-square Wald test was conducted to examine the short-run Granger causality, that is, the combined significance of the coefficient of the explanatory variables. Also, to determine the direction of causality, pairwise Granger causality test based on F-statistics was implemented.

3.4 PARAMETER STABILITY

Since the parameters of a time series can vary overtime leading to model misspecification and spurious results, the stability of the parameters was tested by applying cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests which are based on the recursive regression residuals. The short-run dynamics are incorporated to the long-run coefficients in the stability test through the residuals. The results of the stability tests are presented as graphs with the 5% critical bound. If the plots of the CUSUM and CUSUMSQ are within the critical bounds of 5% significance level, the coefficients are stable. In addition, Jarque-Bera, Breusch-Godfrey Lagrange Multiplier, Breusch-Pagan-Godfrey Heteroskedasticity and Ramsey Regression Equation Specification Error (RESET) tests for normality, serial correlation, heteroskedasticity, and functional form misspecifications were conducted to assess the validity of the results.

4. EMPIRICAL RESULTS AND DISCUSSION

Trend of international air passenger traffic in Nigeria over the period 2018 – 2019 is presented in figure 1. International air passenger traffic increased from 1.196,694 in 1982 to 1,346,352. This was followed by a decline to 935,042, a steady rise to a peak of 4,673,797 in 2014 and decline to 4, 628,350 in 2019. The rise in international air passenger traffic could be due to improvement in the economy.

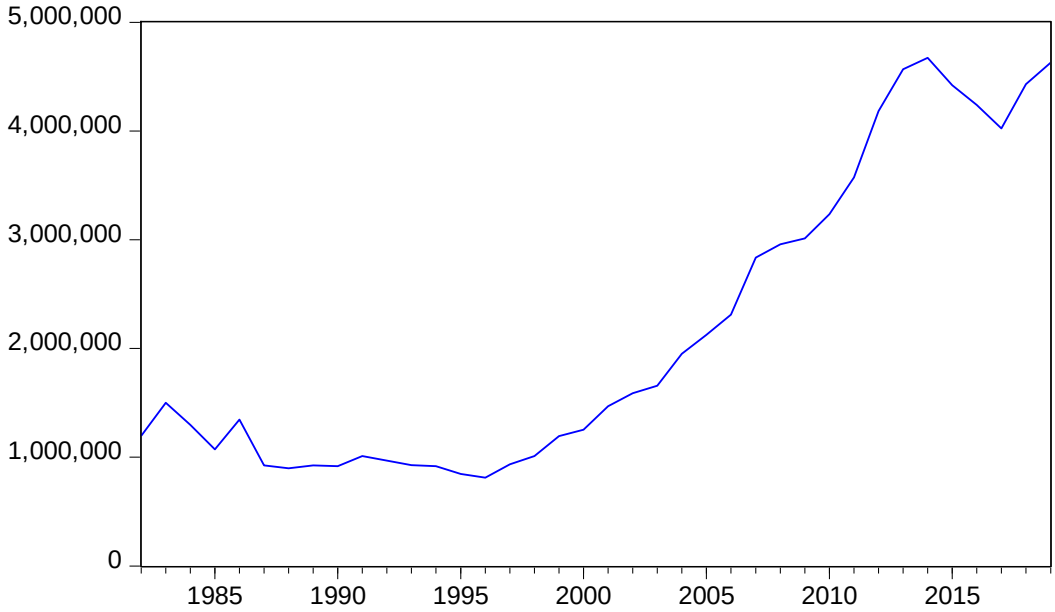


Figure 1. International air passenger traffic in Nigeria, 1982-2019
Source: Annual reports, Federal Airport Authority of Nigeria

4.1 UNIT ROOT TEST RESULT

The DF-GLS unit root test results (table 2) indicate that none of the series is integrated $I(2)$. The series are all integrated of order one, i.e., $I(1)$. The series are non-stationary in level value but are stationary when their first difference are taken. Since the series are non-stationary, the shock effect on the variables are persistent.

Table 2. Results of Dickey-Fuller GLS unit root test

Variable	Deterministic	Level	First Difference
PAX	Individual intercept	0.45	-2.62*
	Individual Intercept and trend	-1.42	-5.79***
TRA	Individual intercept	-0.79	-6.01***
	Individual Intercept and trend	-2.27*	-6.28***
GDP	Individual intercept	-0.54	-2.22*
	Individual Intercept and trend	-1.28	-3.52***
REX	Individual intercept	-2.26*	-4.47***
	Individual Intercept and trend	-2.79	-4.69***
FDI	Individual intercept	-1.12	-9.92***
	Individual Intercept and trend	-1.49	-9.36***

Note: lag length based on Schwarz Bayesian Criterion

4.2 LONG-RUN ANALYSIS RESULTS

The ARDL cointegration approach was used to estimate Eq. (3). The maximum of four lags obtained from unrestricted VAR through Akaike Information Criterion (AIC)

was imposed on the model. A total of 34 observations were included in the analysis. Narayan and Smyth (2004) argued that for small sample sizes, the critical values deviate from the critical values stated by Pesaran, Shin and Smith (2001) which is based on 1000 observations. Based on the critical values for a finite sample size of 35, the estimated F-statistic (10.04) in table 3 is higher than the lower (4.093) and higher (5.532) bound of the critical values at 1% significance level suggesting that the null hypothesis of no cointegration among the variables is rejected. Hence, a long-run relationship exist among the variables.

Results of the long-run coefficients is presented in table 3. The lag order of the ARDL model is 2, 2, 1, 2 and 2. The long-run coefficients of all the macroeconomic variables are statistically significant at 5% significance level except real effective exchange rate. Hence, total real trade, GDP and net foreign direct investment have significant impact on international air passenger travel. The coefficient of total real trade is positive and significant at 5% significance level suggesting that if total real trade increase by 1%, international air passenger traffic will increase by 0.76% in the long-run. This suggest that real trade play an important role in the demand for international travel in Nigeria. This is consistent with findings of Zhang (2015) and Chang (2012) which revealed positive effects of trade on international air passenger travel between countries. Data on Nigeria's trade shows that the value of real import exceed real export as the country depend on her trading partners for various goods including industrial machinery, oil and mineral fuels, motor vehicles and electrical machinery. Real import increased from US$ 97 million in 1982 to a peak of US$163 in million 2007 before declining to US$ 48 million in 2017. On the other hand, real export increased gradually from US$13 million in 1982 to US$71 million in 2019. Growth in international trade lead to increase in international air travel demand due to need for face-to-face contact required for collaboration and monitoring of components moved along global production networks, to overcome information asymmetries and foster confidence with customers and suppliers (Vijver, Derudder, Witlox 2014).

Table 3. Results of estimated long-run coefficients of international air passenger travel

Explanatory variable	Coefficient	Std. error	t-Statistic	Probability
In TRA	0.762825	0.185938	4.102576	0.0008
In GDP	1.003833	0.146959	6.830704	0.0000
In REX	-0.052774	0.081811	-0.645068	0.5280
In FDI	-0.454711	0.113698	-3.999280	0.0010
Constant	-5.652746	4.825746	-1.171372	0.2586
F-statistic	10.04***			

Diagnostic statistics	
LM test	1.948515
Heteroskedasticity	0.423276
Normality	8.2968
Ramsey RESET	0.970218

*** denote significant at 1% significance level. The lower and upper critical bound values of the F-statistic for finite sample of n=35 at 1% significance level is 4.093 and 5.532 respectively.

Real effective exchange rate is negatively associated with international air travel demand in Nigeria but it is not statistically significant at 5% significance level. A possible explanation for the negative sign is that depreciation of the naira increases cost of travel of travelers from Nigeria to international destinations resulting in a negative impact of real effective exchange rate on demand for outbound travel. Since the economy is largely dependent on imports, depreciation of the naira increases prices of goods and disposable income decline leading to reduction in international air travel particularly for leisure and holiday.

The coefficient of GDP is positive and significantly associated with international air travel at 5% significance level indicating that GDP of Nigeria has a significant impact on international air travel demand in the long-run. An increase of 1% in GDP is associated with 1.00% growth in the number of passengers travelling into and from Nigeria by air. Similar positive long-run relationship between GDP and air travel demand was reported by Chi (2014), and Hakim and Merkert (2019). A possible explanation for the positive effect of economic growth on international air travel is that growth in GDP increases disposable income which stimulate demand for business travel, leisure (recreation and holiday), visiting friends and relatives, health and education related trips. Also, economic growth enhance demand for goods and services which stimulates production, trade and investment thereby increasing demand for air travel.

Foreign direct investment is negatively associated with number of air passengers that travel to and from Nigeria by air in the long-run and it is statistically significant at 5% significance level. This suggest that as investment made by foreign individuals and firms into business interests in Nigeria increase, demand for international air travel decrease. A 1% increase in foreign direct investment leads to 0.45% decrease in international air travel. This is contrary to findings by Gillen (2009) which revealed a positive association between foreign direct investment and international air travel. Inflows of FDI in Nigeria fluctuated between 1982 and 1998 before it started increasing gradually in 1999 until it peaked in 2011. During this period, international air traffic increased from 1.1 million in 1999 to 3.5 million in 2011. From 2012, inflows of FDI

started declining up till 2019 while the number of international air passengers continued to grow. Orji et al. (2021), attributed the decline in inflows of FDI to political instability, macroeconomic instability, high inflation, inconsistent economic policies and excessive budget deficit. The growth of international air travel demand in spite of decline in FDI inflows is possibly due to growth in trade.

The long-run coefficients of the variables indicate that the impact of economic growth on international air passenger traffic is the strongest compared to other variables, with a 1% increase in GDP resulting to 1.00% increase in international air travel demand. The magnitude of the effect of trade is also high as 1% increase in trade leads to 0.76% rise in international air travel. Hence, economic growth and total real trade are the main factors influencing international air travel in the long-run.

The diagnostic test result in table 3 shows that the goodness of fit of the model is good since all the results are not significant at 5% significance level. The null hypothesis of no non-normal errors, serial correlation, functional form misspecification, heteroskedasticity, and Ramsey RESET cannot be rejected. Hence, the model is valid and correctly specified.

4.3 SHORT-RUN ANALYSIS RESULTS

The short-run dynamics among the variables was obtained through the estimation of the ECM of Eq. (4). The short-run results in table 4 indicate that the adjusted R-square of the model is 0.85 implying that the model explains 85% of variance in data. The coefficient of international air travel demand is negative with one and two-year lag but positive with a three-year lag. This suggest that the explanatory variables will lead to growth in international air travel after a three-year lag. The coefficient of total real trade has a positive and significant short-run impact on air travel in the current year implying that increase in total real trade leads to growth in air travel in the short-run. Real effective exchange rate has a significant and negative effect on air travel demand similar to its long-run impact. The coefficient of GDP is positive but statistically insignificant at 5% significance level in the current year. With a 1year lag however, the impact of GDP on air travel is positive and statistically significant. It is important to note that the magnitude of the 1-year lag coefficient is stronger. Table 4 also indicate that although the coefficient of FDI is negative, and statistically significant in the current year, the impact of FDI on air travel demand is positive and statistically significant with 1-3 year lag. The magnitude of the coefficient with one-year lag is strongest. The result suggest that FDI will lead to increase in air travel demand in the short-run with 1-3years

lag. Furthermore, the coefficient of the lagged error correction term (ECMt-1) is negative and statistically significant at 5% significance level. The speed of adjustment, -0.57 indicate that convergence to equilibrium once the cointegrating relationship is shocked is rapid. A deviation from the long-run equilibrium due to a short-run shock in the current period will be corrected by 57% after one year. This further confirm the F-statistic result indicating existence of a long-run relationship in the model.

Table 4. Results of estimated short-run dynamics of international air passenger travel

Regressors	ARDL (2,2,1,2,2) Coefficient	Std. Error	t-Statistic	Prob.
Δ In PAX $_{t-1}$	-0.4309	0.0895	-4.8151	0.0002
Δ In PAX $_{t-2}$	-0.3300	0.0826	-3.9977	0.0010
Δ In PAX $_{t-3}$	0.1828	0.0794	2.2989	0.0353
Δ In TRA	0.1199	0.0292	4.1139	0.0008
Δ In TRA $_{t-1}$	-0.0958	0.0436	-2.1974	0.0431
Δ In REX	-0.1207	0.0261	-4.6338	0.0003
Δ In GDP	0.1757	0.2677	0.6561	0.5211
Δ In GDP $_{t-1}$	0.5482	0.2562	2.1392	0.0482
Δ In FDI	-0.0545	0.0145	-3.7516	0.0017
Δ In FDI t_{-1}	0.2293	0.0300	7.6287	0.0000
Δ In FDI $_{t-2}$	0.1685	0.0265	6.3536	0.0000
Δ In FDI $_{t-3}$	0.0823	0.0198	4.1443	0.0008
CointEq(-1)	-0.5696	0.0640	-8.8914	0.0000
R-squared	0.9062			
Adjusted R-squared	0.8526			
Sum of squared residual	0.0369			
Durbin-Watson statistic	1.7505			

4.4 GRANGER CAUSALITY RESULTS

Based on the result of the cointegration test which revealed the existence of a long-run relationship among the variables, Granger causality VECM model was used to determine if there is a long-run causal relationship among the variables. Only the PAX vector was estimated with an ECT. The Granger causality test was applied to other vectors without the ECT since a long-run relationship was not confirmed. The lag length was selected based on the criteria proposed by Hurlin (2004): Ti > 5 + 2K (Ti = time span, K = lag length). A lag length of three was selected based on AIC. The lag length is suitable since it is <1/3 of the total time period as suggested by Holtz-Eakin et al. (1988). Results of the long-run causality test in table 5 shows that the coefficient of the lagged ECT is negative and statistically significant. This confirms the result of the bounds test. In the long-run, total real trade, GDP, real exchange rate and foreign direct investment inflows Granger cause international air passenger traffic. This implies that causality runs interactively through the macroeconomic factors to international air passenger traffic.

The speed of adjustment is lower compared to the ARDL results. This implies that convergence to equilibrium due to a shock is slow.

Table 5. Results of Granger short-run and long-run causality

Dependent Variable	Chi-square Wald test (Probability)					
	Δ InPAX$_t$	ΔInTRA$_t$	Δ InGDP$_t$	ΔInREX$_t$	ΔIn FDI$_t$	ECT$_{t-1}$ (t-statistics)
Δ In PAX$_t$	-	10.51** (0.02)	11.29*** (0.01)	2.47 (0.48)	2.97 (0.39)	-0.14** (0.04)
Δ In TRA$_t$	21.19*** (0.00)	-	9.20** (0.02)	5.25 (0.15)	0.70 (0.87)	
Δ In GDP$_t$	13.17*** (0.00)	3.59 (0.31)	-	8.62** (0.03)	1.82 (0.61)	
Δ In REX$_t$	0.38 (0.94)	0.26 (0.96)	1.92 (0.59)	-	4.19 (0.24)	
Δ In FDI$_t$	6.30 (0.09)	3.92 (0.27)	6.27 (0.09)	1.38 (0.70)	-	

Note: **p<0.05, *** P < 0.01, these represent significant p values

In the short-run, the Chi-square statistic result (table 5) suggest that there is a bidirectional Granger causality between PAX and total real trade, PAX and GDP, total real trade and GDP, as well as a unidirectional causality that runs from GDP to exchange rate at 5% significance level or better. The pairwise Granger causality results (table 6) reveal that the null hypothesis of i) PAX does not Granger cause real trade, ii) PAX does not Granger cause GDP, iii) real trade does not Granger cause PAX, iv) GDP does not Granger cause PAX, v) GDP does not Granger cause exchange rate can be rejected at 5% significance level or better.

Table 6. Summary of pairwise causality results

Direction of causality	F-statistic (Probability_
PAX→TRA	3.84 **(0.02)
TRA→PAX	7.20 ***(0.00)
GDP→PAX	6.89*** (0.00)
PAX→GDP	3.29** (0.03)
GDP→REX	3.21** (0.03)

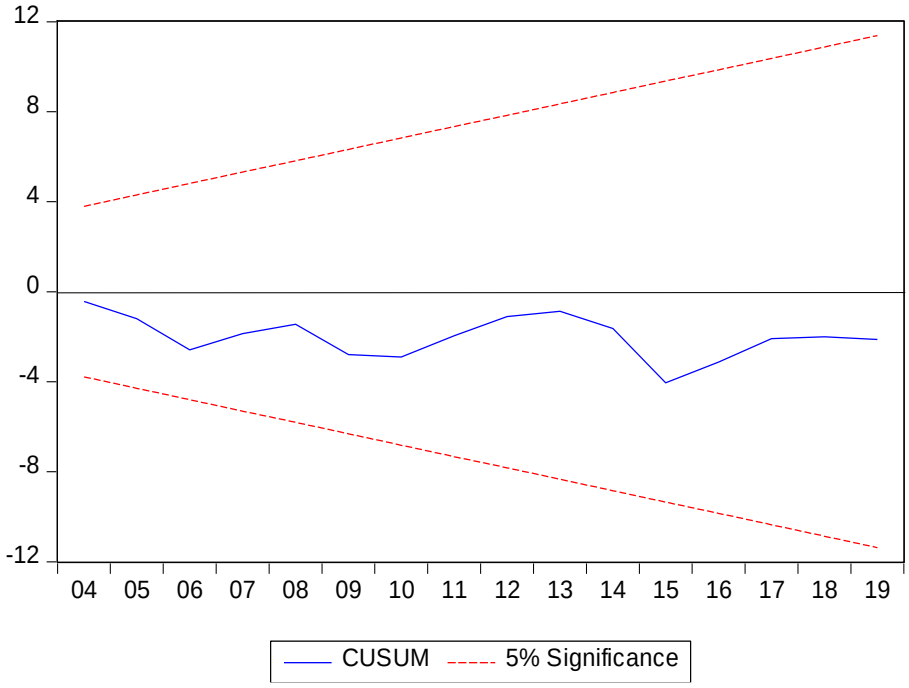
Note: **p<0.05, *** P < 0.01, these represent significant p values

4.5 PARAMETER STABILITY RESULTS

The stability of the coefficients was evaluated using the CUSUM and CUSUMSQ tests. As shown in figure 2, estimated short- and long-run coefficients are stable since the plots of the CUSUM and CUSUMSQ statistic are within the 5% significance level. Therefore,

the parameters of the ARDL model for international air passenger traffic provide sound results.

a)



b)

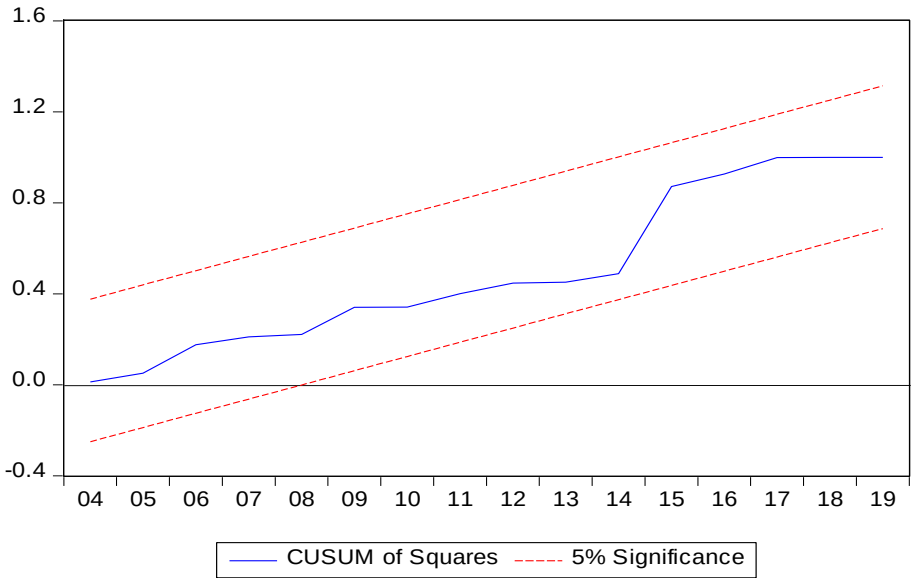


Figure 2. Plots of CUSUM and CUSUM of squares

5. SUMMARY AND CONCLUSION

This paper examined the effect of total real trade, economic growth, real exchange rate and foreign direct investment inflows on international air passenger travel demand in Nigeria using annual data from 1982 to 2019. The ARDL approach was employed to examine cointegration and analyse the short- run dynamics and long-run coefficients simultaneously. Furthermore, Granger causality test was applied to determine causal relationships between international air passenger travel and macroeconomic factors. The empirical results and policy implications are as follows: first, total real trade and GDP are the main factors contributing to the growth of international air travel in Nigeria in both the short-and long-run. With GDP projected to grow by 3.0% in 2023 and as policy measures targeting an increase in share of trade in GDP to 50% by 2023 are being implemented, international air passenger travel demand will increase. Hence, policymakers, airlines and airports need to provide facilities and infrastructure necessary to meet the possible high demand for international air travel. Second, the results highlight the importance of estimating both short–run dynamics and long-run relationships in a model. The effect of GDP and FDI on international air traffic differ in the short-and long-run. While GDP has a strong positive impact on international air travel in the long-run, its positive impact in the short-run manifests after a one-year lag. Also foreign direct investment leads to decline in air travel in the long-run but has a positive impact with 1-3year lags in the short-run. This suggests that strategies that will increase foreign investments such as improvement in trade openness, development of human capital and infrastructures should be implemented so as to increase international air travel demand. Third, our results reveal that long-run causality runs from total real trade, GDP, real exchange rate and foreign direct investment to international air passenger traffic. Since macroeconomic factors impact international air travel demand, development strategies should focus on enhancing economic growth, trade and foreign investments which will then boost international air travel demand.

Furthermore, the bidirectional causality between air passenger traffic and total real trade, air passenger travel and GDP, suggest that increase in international air passenger travel will lead to growth in trade and boost the economy. Thus, measures that will increase international passenger traffic such as reduction in cost of air services, improved safety, connectivity, infrastructures and quality of service need to be implemented by government, policymakers, airlines and airports. Finally, the empirical results provide evidence that real exchange rate is negatively associated with international air passenger traffic in the short term. This implies that monetary policies

that will reduce the depreciation of naira exchange rate and exchange rate volatility needs to be adopted so as to encourage international air travel by residents.

The limitation of this study is that we were unable to explore the effect of the macroeconomic variables on inbound and outbound international air passenger traffic separately mainly due to lack of data. Future research could explore the determinants of bilateral air passenger flows between Nigeria and its major travel partners.

REFERENCES

Abed, S. Y., Ba-Fail, A. O. and Jasimuddin, S. M. (2001), 'An econometric analysis of international air travel demand in Saudi Arabia', Journal of Air Transport Management, 7, 143–148.

Agiomirgianakis, G., Serenis, D. and Tsounis, N. (2015), 'The effects of exchange rate volatility on tourist flows: evidence from the UK and Sweden', International Journal of Tourism Politics, 6 (1), 1–16.

Chang, L.Y. (2012), 'International air passenger flows between pairs of APEC countries: A non-parametric regression tree approach', Journal of Air Transport Management, 20, 4–6.

Chen, J.H., Wei, H.H., Chen, C.L., Wei, H.Y., Chen, Y.P. and Ye, Z. (2020), 'A practical approach to determining critical macroeconomic factors in air-traffic volume based on K-means clustering and decision-tree classification', Journal Air Transport Management, 82, 101743.

Chi, J. (2014), 'A cointegration analysis of bilateral air travel flows: The case of international travel to and from the United States', Journal of Air Transport Management, 39, 41–47.

Chi, J. (2016), 'Exchange rate and transport cost sensitivities of bilateral freight flows between the US and China', Transportation Research Part A, 89, 1–13.

Chi, J. (2020), 'The impact of third-country exchange rate risk on international air travel flows: The case of Korean outbound tourism demand', Transport Policy, 89, 66-78.

Eita, J. H., Jordaan, A. C. and Jordaan, Y. (2011), 'An Econometric Analysis of the Determinants Impacting on Businesses in the Tourism Industry', African Journal of Business Management, 5 (3), 666-675.

Elliot, G., Rothenberg T. and Stock J. (1996), 'Efficient tests for an autoregressive unit root', Econometrica, 64(4), 813–836.

Engle, R.F. and Granger, C.W.J. (1987), 'Cointegration and error correction representation: estimation and testing', Econometrica, 55, 251-276.

Federal Airport Authority of Nigeria: Annual Report 1982-2019.

Fernandes, E. and Pacheco, R.R. (2010), The causal relationship between GDP and domestic air passenger traffic in Brazil', Transportation Planning and Technology, 33 (7), 569–581.

Gillen, D. (2009), International Air Transport in the Future: Bringing citizens closer together. 18th International Transport Research Symposium, OECD/ITF, Madrid, Discussion Paper No. 2009-15.

Hakim, M. and Merkert, R. (2017), 'Econometric evidence on the determinants of air transport in South Asian countries', Transport Policy, 1–7.

Holtz-Eakin, D., Newey, W. and Rosen, H.S. (1988), 'Estimating vector autoregressions with panel data', Econometrica, 56, 1371–1395.

Hurlin, C. (2004), Testing Granger Causality in Heterogeneous Panel Data Models with Fixed Coefficients. University Paris IX, Mimeo.
ICAO (2018). Presentation of 2018 Air transport Statistics Results. Available from https://www.icao.int/annual-report-2018/Documents/Annual.Report.2018_Air%20Transport%20Statistics.pdf2 (accessed on 12/8/2022). 018 Air Transport
Jena, S.K.and Dash, A.K. (2020), 'Does Exchange Rate Volatility Affect Tourist Arrival in India: a Quantile Regression Approach', Regional and Sectoral Economic Studies, 20, 65–78.
Kulendran, N. and Wilson, K. (2000). 'Is there a relationship between international trade and international travel?', Applied Economics, 32 (8), 1001–1009.
Naude, W. A. and Saayman, A. (2005), 'Determinants of Tourist Arrivals in Africa: A Panel Data Regression Analysis', Tourism Economics, 11(3), 365-391.
Oluwakoya, A.O. (2011), 'The Impact of Deregulation and Liberalisation in Nigeria Air Transport Industry: An Overview', Journal of Air Transport Studies, 2, 1, 50-68.
Pacheco, R.R. and Fernandes, E. (2017), 'International air passenger traffic, trade openness and exchange rate in Brazil: A Granger causality test', Transport Research Part A, 101, 22–29.
Pesaran, M.H., Shin, Y. and Smith, R.J. (2001), 'Bounds testing approaches to the analysis of level relationships', Journal of Applied Econometrics, 16(3), 289-326.
Pham, T.D., Nghiem, S. and Dwyer, L. (2017), 'The determinants of Chinese visitors to Australia: A dynamic demand analysis', Tourism Management, 63, 268–276.
Ouattara, B. (2004), Foreign Aid and Fiscal Policy in Senegal. Mimeo University of Manchester, Manchester, UK.
Seetaram, N. (2012), 'Immigration and international inbound tourism: Empirical evidence from Australia', Tourism Management, 33, 1535–1543.
Shrestha, M.B. and Bhatta, G.R. (2018), 'Selecting appropriate methodological framework for time series data analysis', Journal of Finance and Data Science, 4, 71–89.
Valdes, V. (2015), 'Determinants of air travel demand in Middle Income Countries', Journal of Air Transport Management, 42, 75–84.
Van De Vijver, E., Derudder, B.and Witlox, F. (2014), 'Exploring causality in trade and air passenger travel relationships: The case of Asia-Pacific, 1980-2010', Journal of Transport Geogrphy, 34, 142–150.
Webber, A.G. (2001), 'Exchange rate volatility and cointegration in tourism demand', Journal of Travel Research, 39, 398–405.
Zhang, Y. (2015), 'International arrivals to Australia: Determinants and the role of air transport policy', Journal of Air Transport Management, 44–45, 21–24.
Zhang, Y., Qu, H. and Tavitiyaman, P. (2009), 'The determinants of the travel demand on international tourist arrivals to Thailand', Asia Pacific Journal of Tourism Research, 14, 77–92.

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