ECONOMIC GROWTH, MOTORISATION AND ROAD TRAFFIC SAFETY IN NIGERIA

[1] Oluwayemi A. Ayodeji , [2]Yinusa O. Dauda & [3*]Lukman O. Oyelami

[1] Economics Department, Obafemi Awolowo University, Ile-ife, Osun State
[2]Economics Department, Obafemi Awolowo University, Ile-ife, Osun State
[3] Economics Unit, Distance Learning Institute, University of Lagos Akoka, Yaba Lagos.
*Corresponding author's Email: loyelami@unilag.edu.ng

Abstract

The yearning for increasing economic growth has been the focus of many policy makers in the country. This noble objective has come with an increasing level of household wealth which is displayed in form of increasing motorization and may as well compromise the traffic safety in the country. In this connection, this study examines the dynamic causal relationship among economic growth, motorisation and road traffic safety in Nigeria. This is with a view to determining the nexus of economic growth, motorisation and road traffic safety in the country for the period of 1970-2016. To achieve this, secondary data on Gross Domestic Product, Gross Domestic Product Per Capita, Population, nominal exchange rate and the general level of education in the country were sourced from World Development Indicator, Central Bank of Nigeria and Federal Road Safety. The data were analyzed and estimated using the Autoregressive Distributed Lag (ARDL). This was necessary to address the expected endogenity problem and non-uniform stationarity level in our variables. The results from the study demonstrate a unidirectional causal relationship flowing from motorisation to road traffic crash. Similarly, there is unidirectional causal relationship flowing from economic growth to motorisation in Nigeria. In addition, increasing road traffic crash can hamper economic growth. The *study concludes that economic growth contributes to road traffic crash through increasing motorisation in Nigeria. However, an improved level of drivers' education and regulatory effectiveness are required to stem the ugly trend.*

Keywords: Macroeconomics; Safety; ARDL; Nigeria.

JEL Classification: E0, R4, C5

Introduction

Road transportation system is the most widely utilized means of mobility though with significant related advantages and disadvantages. The inherent externality of transportation is emission and crash mortality (Golob & Henscher, 1998). Given the huge benefits accrued from road means of transportation, the accomplished costs in terms of road crash mortality are huge. Road traffic crash occurs when a collision occurs between a moving vehicle with any other object including another vehicle(s) or pedestrians. This usually leads to permanent or temporary wound, dearth and loss of property.

The number of crash facilities recorded on a particular road determines its traffic safety. Hence, if there is an increasing number of fatalities in a country, it will have consequences on the level of socio-economic progress of the region in terms of local and foreign investment (WHO, 2013). The safety of road transport system depends on the availability and effectiveness of important road safety indicators such as safety infrastructural investment, drivers' education and adherence to safety rules and regulations. In addition, vehicle safety engineering design and the effectiveness and efficiency of institutions saddled with implementation and enforcement of road protection policies determine the level of road protection (Arosanyin, 2001). In the developmental process of any nation, the road transport system plays a central role. Apart from serving as a means of moving commodities and people about, it generates substantial employment within the economy and this is an important indicator of economic progress and development.

Economic progress increases the per capita income of individual economic agents vis-à-vis disposable income. This economic prosperity allows for the purchase of more automobiles as a sign of affluence. Though economic growth facilitates an improvement in human quality through access to proper health care, education and training, but road traffic crashes can negate the effect of enormous resources expended on human capital development. The deaths and injuries resulting from road crashes can affect the quality and quantity of human capital endowments that are required for an inclusive economic prosperity (Shalini, 2009). The consequences associated with road traffic crashes on economic progress apart from death and physical disabilities often make people unemployable and have an enormous psychological impact. Several studies of traffic crashes based on epidemiology have indicated that most casualties of road crashes are productive adult's component of the population between 30 and 49 years (WHO, 2013). Being the most active part of the population, the resultant effect is the economic burden not only on the dependent population for the loss of their breadwinners but also loss of productivity to nation (Adekunle, 2010; Yusuf, 2015).

The road safety situation in Nigeria is so deplorable that the World Health Organisation once describes the country's road as the worst in the world to travel on next to Ethiopia (WHO, 1984). The global status report on road traffic crashes revealed that annual road traffic deaths has reached 1.34million and loss of about 3% of Gross Domestic Products (GDP). Similarly, as of December 2018, a total of 9,741 crashes were recorded, an increase of 3.8% from 2017. Also, 5,181 fatalities were recorded representing an increase of 1.2% from 2017 (FRSC Annual Report, 2018). Road traffic crashes aside from being among the top three leading causes of death in Nigeria, depletes nation's manpower and negatively affect the economy. The advent of automobiles as a means of transportation and the consequences emanating from human handling and usage has posed a serious concern to safety and mobility generally. It may be logical to think that safety is a guarantee on road without moving vehicles but automobiles are necessary for human mobility in the process of economic development. Therefore, it is expedient to address the issues of road protection in Nigeria with a focus on increase motorisation.

Since road traffic crash is somehow an unavoidable occurrence in the course of the nation's economic advancement because, as the economic activities expand, there is the need for transportation of intermediate and finished products, drivers always in a hurry, a kilometer of travels increase and the chance of road accident and fatalities (Kopits & Croppers, 2005). Despite the importance of car ownership to the increasing quality family lives it also connects to families bereave of their loved ones. This paper attempts to examine the effect of economic growth on the rate of motorisation in a country without a commensurate increase in quality and quantity of road network and consequential effect on road traffic safety.

There are a series of arguments about the nexus between economic advancement and developments in general and the traffic crashes intensity for a long time. Peltzman (1975) explained the influence of income on driving behaviour and consequential effect on crash threat. A number of studies show that growth and development can explain the variations in road traffic safety. Furthermore, the existing studies in Nigeria explain the morbidity consequence of traffic crashes intensity

(Oluwaseyi & Gbadamosi, 2017; Onyemaechi & Ofoma, 2016). However, most of these studies do not take into cognizance the nexus of economic growth, motorization and road traffic safety in Nigeria. This serves as an important gap for this study to be filled. More importantly, this study employs a more comprehensive measure of road traffic safety.

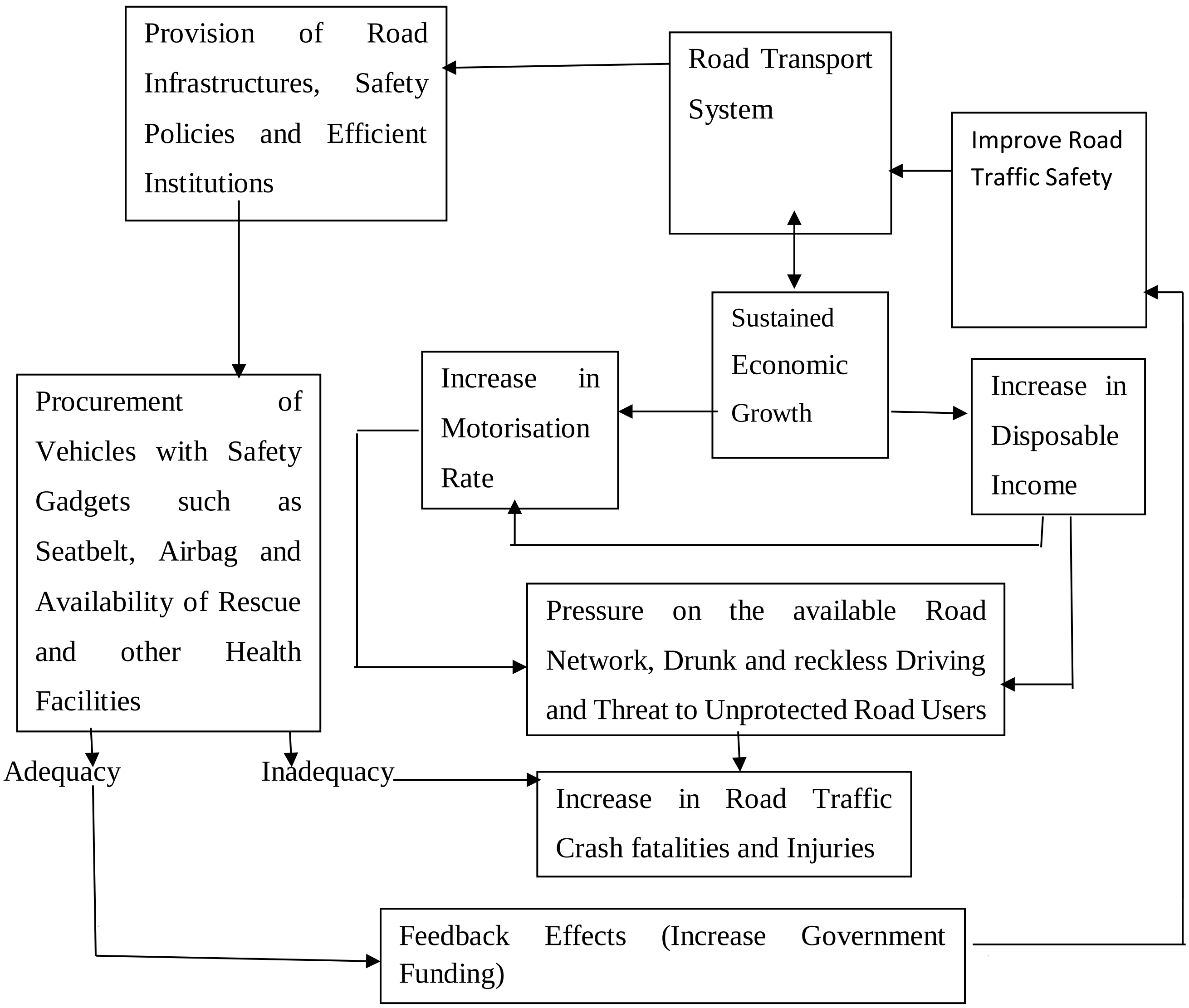
While this section introduces the study, section two reviews extant literature and section three presents the methodology that guide the study. The last section of the study focuses on the results presentation and discussion.

Literature Review

Economic growth, motorisation and road traffic safety: The link

Evidence exists in the literature that increase in per capita income will enhance households' access to higher disposable income and consequently increase the number of vehicles on the road (Bishai, Quresh, James & Ghaffar, 2006). Several studies have argued that at bottom levels of income, road traffic mortalities per 100,000 of the population correspond with an increase in income due to an increase in motorisation. However, a sustained increase in income vis-vis rise in motorisation rate to a certain extent subsequently declines the rate of fatalities. The decline may be as a result of road infrastructural development, investment in safety measures (including safer cars), regulatory effectiveness, and behavioural change through road users' education (Kopits & Cropper, 2005; Bishai *et. al*, 2006; Anbarci, Escaleras & Register, 2006). The increase in road traffic crash fatalities maybe because of decay road infrastructures, lack of safety education, safety regulations and weak enforcement of traffic laws. Therefore, an increase in the number of vehicle ownership that is not accompanied by adequate infrastructure, safety education, legislation and enforcement will lead to crashes on the road. In a similar study by Dargay, Gately and Sommer (2007), sustained growth and development are inherent to rising motorisation through the increases in per capita income and urbanisation. The study argued that by 2030, the volume of number vehicles globally would have increased from the year 2002 estimate of 800 million to over two billion, with China accounting for 20% of the world vehicle fleet.

The interconnection between a safe and efficient transport system and growth in a developing economy like Nigeria has been long recognised (figure 1). In the course of growth and development, commodities and services are needed to be safely moved from one place to another in order to avoid loss of these resources to road carnage. Ighodaro (2008) who contended that a safe road network is important for investment, trade and poverty alleviation corroborated this point. Road improvements act as some intermediate materials in the production process for other sectors of the economy and thereby raise factor productivity. It also serves as an economic balance through the distribution of material resources, production inputs, and finished products across the nation.



Source: Author, 2019.

Business cycle and traffic safety

Traffic safety rates indicate substantial movement from one period to another and there is evidence that this movement synchronizes with the business cycle. In the period of low industrial production as a result of poor economic performance, the per capita death rate is low (Wilde, 1996). The argument establishes the link between increased traffic death rate and economic prosperity. This may be associated with an increased tendency of people to take more risk on the road during an economic boom.

Empirical review of literature

Soderland and Zwi (1995) examined economic growth and traffic-related fatality in 83 industrialized and less industrialized parts of the globe in 1990. Employing multiple regression analysis, the investigation discovers that a rise in gross national product per capita and health care spending can be linked to a reduction in mortality rates among traffic crash casualties, especially in developed countries. The study is however silent about motorisation as an intervening variable. Similarly, Yannis, Papadimitriou and Folla (2014) examined the relationship between changes in Gross Domestic Product (GDP) and yearly road traffic accident dearth rates in 27 European countries between 1975 and 2011. Using mixed linear models, the study revealed evidence to establish a positive and significant association between increase annual GDP per capita and fatality rates. In addition, their results confirmed a negative and significant linkage between recession and fatality rates in the selected countries. However, the study focused only on short-run the dynamic relationship between variables of interest.

He, Paichadze, Hyder and Bishai (2015) employed panel data to examine the relationship among gross state commodities, road traffic fatalities and a set of relevant exogenous variables such as territory, number of people, size of public motor roads in Russia from 2004- 2011. The findings show that road traffic fatalities decrease monotonically over time as gross regional product per capita increased in the 66 studied regions of Russia. Hamed (2015) investigates the contributing factors to the disparities in road fatality in developed and emerging countries from 1990-2010. Using panel modelling data analysis, he finds a negative relationship between road fatalities and macroeconomic factors such as unemployment and GDP per population. He, however, affirmed unemployment to have exhibited a stronger negative relationship. Arosanyin (2001) examines the economic impact of road traffic accident casualties in Nigeria between 1980 and 1995. The finding shows that road accident and its associated casualties had been on the decline in absolute terms, the casualty ratios were still very severe, which was reflected in deteriorating personal and system safety. Yusuff (2015) investigates the degree of influence of road traffic crashes on economic performances in Nigeria between 1990 and 2013. Her investigation shows a negative linkage between GDP Per Capita, total road coverage and road traffic crashes.

Bougueroua and Carnis (2016) examines the effect of economic condition and mobility on road traffic crashes in Algeria during the period of 1973 to 2013 using different methodology. The study employed a dynamic econometric approach and finds that GDP per capita has a positive influence on road traffic accidents in both the short and long run. The implication of this is that, rising economic activities worsen road traffic condition but effective public policy could ameliorate the condition thus the need for strong political intervention towards reducing road crashes. Borsos (2011) models road protection as a function of motorisation rate using a country-level as well as a time-dependent on 26 countries based on the availability of data from 1965 to 2009. This modelling involved two coefficients for each country per year as well as discussions on their changes over time. The study reveals that fatality rate reduces over time in some countries, which may be as a result of improvement in infrastructures as well as better training and skill due to education and experience. Hence, variations in safety awareness among nations exist because of the rate at which safety laden education and information are being inculcated in these countries. Bener and Yousif (2011) investigate the road traffic mortality using both linear analyses and Smeed's equation. Data on GDP, cars, population and fatalities over the period of 26 years sourced from the state of Qatar to examine the relationship between economic growth and traffic fatalities. The study did not only find that Smeed's formula gives a higher estimation of road traffic fatalities in Qatar than regression analysis but also establish the existence of a positive relationship between economic performance and traffic mortality.

Peltzman (1975) examines the impact of disposable personal income on traffic mortality rates in United States of America and discovers a negative correlation between per capita traffic fatality and income growth among states in the U.S. Johnson and Witt (1986) find that new vehicle demand has a positive significant relationship with disposable income. Increase in individual income should translate to increase demand for automobile safety gadgets. Additionally, Blomquist (1979) finds that people with higher level of comfort are required to be more cautious in driving and the use of safety devices based on the fact they may be relieved of their job due to injury. Peltzman, Johnson & Witt and Blomquist were of the opinion that increase in income will always translate to a reduction traffic-related fatality. Their studies reveal that increase in income will bring infrastructural development such as good roads, medical facilities and people will be able to buy vehicles fitted with safety gadgets. Also, improvement in the level of education and awareness will engender a safe driving culture.

Wiebe, Ray, Maswabi, Kgathi and Branas (2016) access advancement indicators and vehicle crash mortality levels in Botswana and Zambia over a period of 42 years using Vector Autoregressive and Granger causality tests. The result of the investigation reveals that road crash mortalities increases in both Zambia and Botswana in recent decades. The economic progress in Botswana has resulted in a proportionate increase in road traffic fatalities over this period. Similarly, Rezaei, Lankarani, Matin, Bazyar, Hamzeh, and Najafi (2015) investigates the factors causing traffic crash mortality in Iran during the period of 1991 and 2011. Time series autoregressive distributed lag analysis and error correction model were employed to examine the long and short-run effect of variables such as gross domestic product per capita, number of doctors per 10,000 populations, degree of urbanisation, unemployment rates and motorisation rates on road traffic crash fatalities. Empirical results show that there is a significant impact of doctor per 10,000 populations on GDP per capita, degree of urbanisation and motorisation rate on fatality.However, the study did not consider the short and long-term effect of unemployment rates on road traffic fatalities in Iran. This implies that a better understanding of factors affecting road traffic fatalities is a necessary template for health policymakers.

Also, Ageli and Zaidan (2013) investigate the interrelationship between road traffic crashes and some relevant economic variables in Saudi Arabia. Time series data from 1971 to 2012 was employed to estimate the autoregressive distributed lag model. Results show that the relationship between road traffic crashes, gross domestic product, population, motorisation and number of drivers' license is very strong. On the feedback effect, Levinson (2016) examines mutual causality between the growth of road networks, economic development, changes in county-level population and employment. Using panel data from Minnesota over the period 1988 to 2007 to fit a model, the study found a bi-directional causality between population and local road networks, but no evidence of causality is found between networks and local employment. Employing Ordinary Least Square (OLS), Enu (2014) examines the impact of road traffic crashes on economic growth and also determined the effect of macroeconomic variables on road traffic crashes in Ghana. The study confirms a feedback effect of road traffic crashes and fatalities on economic growth. In addition, macroeconomic variables such as Gross Domestic Product (GDP), GDP per capita and government spending affect road traffic crashes in Ghana.

In Nigeria, a study by Ohakwe, Iwueze and Chikezie (2011) carried out an analysis of road traffic accidents in southeastern Nigeria using time series decomposition approach. The study reports an upward trend in traffic road accidents and identify reckless driving, inexperience and mechanical fault as major cause of traffic road accidents. Another study in the country by Yusuff (2016) investigates the effect of road traffic accidents on economic growth and social economic determinants of road traffic accidents. Using a regression technique, the study found that road traffic accidents has a negative effect on Nigerian economy and social economic factors such as poverty and limited road network contributes to road traffic accidents. This study can be considered as one directional study due inability to capture the reversed relationship between road traffic accidents and economic growth. This important gap and many more constitute the contributions of this study.

Methodology

Smeed's model of fatalities, vehicle ownership and economic growth is adapted with modification in equation 1a,1b and 1c for this study.

$$(F/P)_t = \beta_0 + \beta_1 Y_t + \beta_2 (MOT)_t + \beta_3 Z_t + e_i \quad (1a)$$

$$Y_t = \theta_0 + \theta_1 (F/P)_t + \theta_2 (MOT)_t + \theta_3 Z_t + e_i \quad (1b)$$

$$(MOT)_t = \alpha_0 + \alpha_1 (F/P)_t + \alpha_2 Y_t + \alpha_3 Z_t + e_i \quad (1c)$$

Where F/P is fatality per 100,000 of the population, Y is the real per capita GDP (2005 international prices). Per capita GDP is used as proxy for economic growth because it gives a more stable measure of economic performance and goes beyond mere growth. MOT stands for motorization and it is measured by vehicle in use/no of registered vehicles per 1000 of the population; Z_t Inflation; Secondary School Enrolment (EDU); Exchange Rate; and e_i is the error term. β, θ and α .The inclusion of inflation and exchange is because automobiles form major item of the country' importation and these variables determine the prices at the international market. β, θ and δ are coefficients of dependent variables in equation 1a, 1b and 1c respectively. The model is specified in Autoregressive Distributed Lag (ARDL) form with an effort to incorporate the lag value of selected variables. The ARDL of Pesaran *et al*. (1996, 2001) does not make an order of integration important since the procedure is suitable for either $I(0)$ or $I(1)$ or mixed integration.

$$y_t = \sum_{j=1}^{n} \lambda_i y_{t-j} + y_t + \sum_{j=1}^{q} \delta_i \chi_{t-j} + \varepsilon_t \quad (2)$$

As specified in equation (2), y_t stands as the independent variable and x_t serves as the vector of the induced variable. In addition, λ_t and δ_t stands as the coefficient of vectors for scalars and independent variables and ε_t is the error term. Explicitly, the equation can be specified as follow:

$$\Delta y_t = \varphi y_{t-j} + \dot{\beta}_1^* \chi_t + \sum_{j=1}^{n-1} \lambda_1^* \Delta y_{t-j} + \sum_{j=1}^{q-1} \delta_1^* \Delta x_{t-j} + \varepsilon_t \quad (3)$$

Incorporating both explained and explanatory variables in the linear ARDL estimation in equation (4) to (9)

$$\Delta FPOP_t = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} \Delta FPOP_{t-i} + \sum_{i=1}^{q} \lambda_{2i} \Delta PGDP_{t-i} + \sum_{i=1}^{q} \lambda_{3i} \Delta MOT_{t-1} + \sum_{i=1}^{q} \lambda_{4i} \Delta EDU_{t-1} + \sum_{i=1}^{q} \lambda_{5i} \Delta \mathrm{INF}_{t-1} + \sum_{i=1}^{q} \lambda_{6i} \Delta \mathrm{EXR}_{t-1} + \theta_0 FPOP_{t-1} + \theta_1 PGDP_{t-1} + \theta_2 MOT_{t-1} + \theta_3 EDU_{t-1} + \theta_4 INF_{t-1} + \theta_5 EXR_{t-1} + \varepsilon_t \quad (4)$$

$$\Delta PGDP_t = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} \Delta PGDP_{t-i} + \sum_{i=1}^{q} \lambda_{2i} \Delta FPOP_{t-i} + \sum_{i=1}^{q} \lambda_{3i} \Delta MOT_{t-1} + \sum_{i=1}^{q} \lambda_{4i} \Delta EDU_{t-1} + \sum_{i=1}^{q} \lambda_{5i} \Delta \mathrm{INF}_{t-1} + \sum_{i=1}^{q} \lambda_{6i} \Delta \mathrm{EXR}_{t-1} + \theta_0 PGDP_{t-1} + \theta_1 FPOP_{t-1} + \theta_2 MOT_{t-1} + \theta_3 EDU_{t-1} + \theta_4 INF_{t-1} + \theta_5 EXR_{t-1} + \varepsilon_t \quad (5)$$

$$\Delta MOT_t = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} \Delta MOT_{t-i} + \sum_{i=1}^{q} \lambda_{2i} \Delta FPOP_{t-i} + \sum_{i=1}^{q} \lambda_{3i} \Delta PGDP_{t-1} + \sum_{i=1}^{q} \lambda_{4i} \Delta EDU_{t-1} + \sum_{i=1}^{q} \lambda_{5i} \Delta \mathrm{INF}_{t-1} + \sum_{i=1}^{q} \lambda_{6i} \Delta \mathrm{EXR}_{t-1} + \theta_0 MOT_{t-1} + \theta_1 FPOP_{t-1} + \theta_2 PGDP_{t-1} + \theta_3 EDU_{t-1} + \theta_4 INF_{t-1} + \theta_5 EXR_{t-1} + \varepsilon_t \quad (6)$$

$$\Delta EDU_t = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} \Delta EDU_{t-i} + \sum_{i=1}^{q} \lambda_{2i} \Delta FPOP_{t-i} + \sum_{i=1}^{q} \lambda_{3i} \Delta PGDP_{t-1} + \sum_{i=1}^{q} \lambda_{4i} \Delta MOT_{t-1} + \sum_{i=1}^{q} \lambda_{5i} \Delta \mathrm{INF}_{t-1} + \sum_{i=1}^{q} \lambda_{6i} \Delta \mathrm{EXR}_{t-1} + \theta_0 EDU_{t-1} + \theta_1 FPOP_{t-1} + \theta_2 PGDP_{t-1} + \theta_3 MOT_{t-1} + \theta_4 INF_{t-1} + \theta_5 EXR_{t-1} + \varepsilon_t \quad (7)$$

$$\Delta INF_t = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} \Delta INF_{t-i} + \sum_{i=1}^{q} \lambda_{2i} \Delta FPOP_{t-i} + \sum_{i=1}^{q} \lambda_{3i} \Delta PGDP_{t-1} + \sum_{i=1}^{q} \lambda_{4i} \Delta MOT_{t-1} + \sum_{i=1}^{q} \lambda_{5i} \Delta \mathrm{EDU}_{t-1} + \sum_{i=1}^{q} \lambda_{6i} \Delta \mathrm{EXR}_{t-1} + \theta_0 INF_{t-1} + \theta_1 FPOP_{t-1} + \theta_2 PGDP_{t-1} + \theta_3 MOT_{t-1} + \theta_4 EDU_{t-1} + \theta_5 EXR_{t-1} + \varepsilon_t \quad (8)$$

$$\Delta EXR_t = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} \Delta EXR_{t-i} + \sum_{i=1}^{q} \lambda_{2i} \Delta FPOP_{t-i} + \sum_{i=1}^{q} \lambda_{3i} \Delta PGDP_{t-1} + \sum_{i=1}^{q} \lambda_{4i} \Delta MOT_{t-1} + \sum_{i=1}^{q} \lambda_{5i} \Delta \mathrm{EDU}_{t-1} + \sum_{i=1}^{q} \lambda_{6i} \Delta \mathrm{EXR}_{t-1} + \theta_0 EXR_{t-1} + \theta_1 FPOP_{t-1} + \theta_2 PGDP_{t-1} + \theta_3 MOT_{t-1} + \theta_4 EDU_{t-1} + \theta_5 INF_{t-1} + \varepsilon_t \quad (9)$$

Where Δ is the first difference operator; λ denotes the regression coefficients, and the lag order q selected by Akaike's Information Criterion (AIC). $\Delta FPOP_{t-i}$, $\Delta PGDP_{t-i}$, $\Delta INFL_{t-i}$, ΔEXR_{t-i}, ΔEDU_{t-i}, and ΔMOT_{t-i} are Road Traffic Safety measured in terms of road fatalities per population, per capita GDP, Inflation, Exchange Rate, Secondary School Enrolment, and Motor Vehicles in Use per thousand of the population respectively. The residuals ε_t are assumed to be normally distributed and white noise. The Lamder signs (λ) indicate the short run dynamics of the model while θ_0 to θ_5 represent the long-run relationship. Before performing the ARDL model, there is the need to test for the level of integration of all the variables with Augumented Dickey-Fuller (ADF) (Dickey & Fuller, 1979) and Philips-Perron (PP) (Phillips- Perron, 1988) because if any variable is I(2) or above, ARDL is not applicable.

The study therefore employs the bounds testing co-integration framework following Toda and Yamamoto, 1995 approach to examine long-run equilibrium interactions among the variables employed for the study (Pesaran, Shin & Smith, 2001). Following Pesaran, Shin and Smith, (2001), one can use the F-test (Turner, 2006) to investigate the existence of a long-run relationship by imposing restriction on the coefficients of the lagged level variables H_0: $\theta_0 = \theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = 0$ from equations (4) to (9) and H_1: $\theta_0 \neq \theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq \theta_5 \neq 0$. If the long run relationship between variables are established then there must be short- and long-run dynamics or causality (Granger, 1988). The coefficient will be estimated using the following error correction models.

$$\Delta FPOP_t = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} \Delta FPOP_{t-i} + \sum_{i=1}^{q} \lambda_{2i} \Delta PGDP_{t-i} + \sum_{i=1}^{q} \lambda_{3i} \Delta MOT_{t-1} + \sum_{i=1}^{q} \lambda_{4i} \Delta EDU_{t-1} + \sum_{i=1}^{q} \lambda_{5i} \Delta \mathrm{INF}_{t-1} + \sum_{i=1}^{q} \lambda_{6i} \Delta \mathrm{EXR}_{t-1} + \gamma ECT_{t-1} + \varepsilon_t \quad (10)$$

$$\Delta PGDP_t = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} \Delta PGDP_{t-i} + \sum_{i=1}^{q} \lambda_{2i} \Delta FPOP_{t-i} + \sum_{i=1}^{q} \lambda_{3i} \Delta MOT_{t-1} + \sum_{i=1}^{q} \lambda_{4i} \Delta EDU_{t-1} + \sum_{i=1}^{q} \lambda_{5i} \Delta \mathrm{INF}_{t-1} + \sum_{i=1}^{q} \lambda_{6i} \Delta \mathrm{EXR}_{t-1} + \gamma ECT_{t-1} + \varepsilon_t \quad (11)$$

$$\Delta MOT_t = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} \Delta MOT_{t-i} + \sum_{i=1}^{q} \lambda_{2i} \Delta FPOP_{t-i} + \sum_{i=1}^{q} \lambda_{3i} \Delta PGDP_{t-1} + \sum_{i=1}^{q} \lambda_{4i} \Delta EDU_{t-1} + \sum_{i=1}^{q} \lambda_{5i} \Delta \mathrm{INF}_{t-1} + \sum_{i=1}^{q} \lambda_{6i} \Delta \mathrm{EXR}_{t-1} + \gamma ECT_{t-1} + \varepsilon_t \quad (12)$$

$$\Delta EDU_t = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} \Delta EDU_{t-i} + \sum_{i=1}^{q} \lambda_{2i} \Delta FPOP_{t-i} + \sum_{i=1}^{q} \lambda_{3i} \Delta PGDP_{t-1} + \sum_{i=1}^{q} \lambda_{4i} \Delta MOT_{t-1} + \sum_{i=1}^{q} \lambda_{5i} \Delta \mathrm{INF}_{t-1} + \sum_{i=1}^{q} \lambda_{6i} \Delta \mathrm{EXR}_{t-1} + \gamma ECT_{t-1} + \varepsilon_t \quad (13)$$

$$\Delta INF_t = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} \Delta INF_{t-i} + \sum_{i=1}^{q} \lambda_{2i} \Delta FPOP_{t-i} + \sum_{i=1}^{q} \lambda_{3i} \Delta PGDP_{t-1} + \sum_{i=1}^{q} \lambda_{4i} \Delta MOT_{t-1} + \sum_{i=1}^{q} \lambda_{5i} \Delta \mathrm{EDU}_{t-1} + \sum_{i=1}^{q} \lambda_{6i} \Delta \mathrm{EXR}_{t-1} + \gamma ECT_{t-1} + \varepsilon_t \quad (14)$$

$$\Delta EXR_t = \lambda_0 + \sum_{i=1}^{p} \lambda_{1i} \Delta EXR_{t-i} + \sum_{i=1}^{q} \lambda_{2i} \Delta FPOP_{t-i} + \sum_{i=1}^{q} \lambda_{3i} \Delta PGDP_{t-1} + \sum_{i=1}^{q} \lambda_{4i} \Delta MOT_{t-1} + \sum_{i=1}^{q} \lambda_{5i} \Delta \mathrm{EDU}_{t-1} + \sum_{i=1}^{q} \lambda_{6i} \Delta \mathrm{EXR}_{t-1} + \gamma ECT_{t-1} + \varepsilon_t \quad (15)$$

γ, the coefficient of the error correction term ECT_{t-1} stands for the short run speed of adjustment into long-run equilibrium and its ranges from zero to minus one. The residuals ε_t are based on the assumption of normality and the white noise ECT_{t-1} is one period lagged error-correction term derived from the co-integrating equation. ARDL framework with a view to determining the relationships and feedback effects among dependent and independent variables in both short and long run using equation (4) to (9) while error correction estimation techniques will be employed to ascertain the direction of causality through models (10) to (15).All our Data were sourced from World Development Indicator, Central Bank of Nigeria and Federal Road Safety.

Presentation of Results and Discussion

Descriptive statistics of the variables

The results of Descriptive analysis marks the beginning of results presentation. As expected, it embraces the measures of central tendency and variation majorly mean, median and standard variation. Performing descriptive statistics prior to analyzing time series data has become imperative in order to identify the properties of the data. Table 1 presents the descriptive statistics of the variables. From Table 1, the total number of observations used is 47. All the variables used were expressed in their natural form. The mean of fatality per population (FPOP), secondary school enrolment (EDU), exchange rate (EXR), motorisation rate (MOT), inflation rate (INFL), real gross domestic product (RGDP) and per capita gross domestic product (PGDP) are 7.3670, 58.7201, 18.5903, 23.6378, 2.96E+13, 803.2979 and 91.5096 respectively. Furthermore, the median values of the variables are 6.9300, 21.8844, 12.8766, 11.4800, 2.07E+13, 437.0000 and 79.2200 for fatality per population (FPOP), secondary school enrolment (EDU), an exchange rate

(EXR), motorization rate (MOT), inflation rate (INFL), real gross domestic product (RGDP) and per capita gross domestic product (PGDP) respectively. In the same way, the mean and the median of all variables in the data set are within the minimum and maximum ranges.

Furthermore, the result from the standard deviation employed to measure the spread of the data indicates that real gross domestic product is the most widely disperse variable. By implication, the real gross domestic product has been unstable over the study period. Skewness, on the other hand, measured the asymmetry of the distribution of the series around its mean. The skewness of a normal distribution was zero. Positive skewness indicated that the distribution has a long right tail and negative skewness demonstrated that the distribution has a long left tail. From Table 1, it was observed that all the variables are positively skewed and as such, they have long right tails. By implication, their mean was greater than their median and median greater than the mode.

Similarly, kurtosis statistics was used to measure the peakedness or flatness of the distribution of the series. If the kurtosis statistic was above three, the distribution would peak or become leptokurtic relative to the normal and if the kurtosis was less than three, the distribution would be flat or would turn the platykurtic relative to normal. From Table 1, motorisation rate (MOT), inflation rate (INFL) and real gross domestic product (RGDP) peaked or were leptokurtic because their values were greater than three, while fatality per population (FPOP), secondary school enrolment (EDU), an exchange rate (EXR) and per capita gross domestic product (PGDP) values were less than three, therefore, the variables were platykurtic.

The Jarque-Bera test statistic was used to test for normality in the distribution of the series. It measured the difference of the skewness and kurtosis of the series with those with the normal distribution. From Table1, Jarque-Bera probability revealed that fatality per population (FPOP), an exchange rate (EXR) and per capita gross domestic product (PGDP) have a normal distribution while other variables such as secondary school enrolment (EDU), motorisation rate (MOT), inflation rate (INFL) and real gross domestic product (RGDP) rejected the normality assumption. Since Autoregressive Distributed Lag (ARDL) and Vector Autoregressive approach were used in this study, therefore they addressed the problem of non-normality among the variables.

Table 1: Descriptive Statistics of Variables

	FPOP	EDU	EXR	INFL	MOT	RGDP	PGDP
Mean	7.367	24.412	58.720	18.590	23.637	2.96E+13	803.297
Median	6.930	24.060	21.884	12.876	11.480	2.07E+13	437.000
Maximum	14.690	48.600	253.492	72.835	85.380	6.98E+13	3203.000
Minimum	2.680	4.410	0.546	3.457	1.790	1.52E+13	153.000
Stand. Dev.	3.334	12.691	70.651	16.064	27.459	1.70E+13	851.362
Skewness	0.387	0.058	0.821	1.845	1.372	1.248	1.677
Kurtosis	2.065	2.300	2.386	5.534	3.174	3.038	4.416
Jarque-Bera	2.889	0.987	6.013	39.237	14.811	11.944	25.968
Probability	0.236	0.610	0.060	0.0000	0.001	0.003	0.000
Observation	47	47	47	47	47	47	47

Where FPOP is fatality per population, FVEH is fatality per vehicle, EDU is secondary school enrolment, EXR is exchange rate, MOT is motorization rate, INFL is inflation rate, RGDP is real gross domestic product and PGDP is per Capital Gross Domestic Product

Source: Authors' Computation, 2019

Unit root test

Usually, testing for non-stationarity in the form of unit roots has become a standard practice in econometric procedures (Engle & Granger, 1987). This is due to the challenges that the presence of unit-root can cause to econometric estimations such as Ordinary Least Square Method (OLS). For instance, it has been documented that OLS gives spurious results in the presence of unit-root. When this occurs, estimation is reduced to mere common trends and not the inherent linkages between two or more variables. An inadequate account of unit roots can produce false estimation and this when the relationship appears to be significant and meaningful only to be meaningless and insignificant in reality (Hamilton, 1994). Hence, in order to make sure the series is free of I(2) variables, the study employed the Augmented Dickey-Fuller (ADF) (1979) and the Phillips-Perron (PP) (1998) unit root tests. The results are presented in Tables 2 and 3. Table 2 presents the unit root test with intercept, while Table 3 presents the unit root test with both intercept and trend. The unit root test in Table 2 shows that inflation was stationary at a level using both ADF and PP tests. Other variables were stationary at the first difference, indicating an I(1) series. In order to confirm the unit root result in Table 2 (with intercept), a unit root test with both trend and intercept is presented in Table 3. The result also confirms the result obtained in Table 2 except for fatality per population (FPOP) which is stationary at a level using the ADF test. Since all the variables are a mixture of I(0) and I(1) variables, this allows the use of dynamic model such as autoregressive distributed lags (ARDL).

Table 2: Unit Root Test (With Intercept)

	Augmented Dickey-Fuller (ADF) Test			Philip-Perron (PP) Test		
Variables	Level	1st Difference	Status	Level	1st Difference	Status
FPOP	-0.70 (0.834)	-5.37 (0.000)*	I(1)	-0.85 (0.793)	-5.31 (0.000)*	I(1)
EDU	-0.79 (0.811)	-3.22 (0.025)**	I(1)	-0.22 (0.928)	-3.02 (0.040)**	I(1)
EXR	2.02 (1.000)	-4.00 (0.0032)*	I(1)	1.81 (1.000)	-4.00 (0.003)*	I(1)
INFL	-3.35 (0.018)**	-	I(0)	-3.18 (0.027)**	-	I(0)
MOT	0.35 (0.978)	-6.15 (0.000)*	I(1)	0.33 (0.978)	-6.13 (0.000)*	I(1)
RGDP	2.41 (1.000)	-4.14 (0.002)**	I(1)	1.89 (1.000)	-4.22 (0.002)*	I(1)
PGDP	0.01 (0.954)	-6.41 (0.000)*	I(1)	-0.18 (0.934)	-6.46 (0.000)*	I(1)

Note:

*(1) *** = 1%, ** = 5%, * = 10% significant level*

(2) () are probabilities values

(3) For ADF test, automatic maximum lag based on Schwarz information criterion is applied while PP tests, the automatic maximum lag length based on Newey-West Bandwidth is applied

(4) Where FPOP is fatality per population, FVEH is fatality per vehicle, EDU is secondary school enrolment, EXR is exchange rate, MOT is motorisation rate, INFL is inflation rate, RGDP is real gross domestic product and PGDP is per Capita Gross Domestic Product . Author's Computation 2019

Table 3: Unit Root Test (With Trend and Intercept)

	Augmented Dickey-Fuller (ADF) Test			Philip-Perron (PP) Test		
Variables	Level	1st Difference	Status	Level	1st Difference	Status
FPOP	-3.36 (0.069)***	-	I(0)	-3.03 (0.134)	-5.52 (0.000)*	I(1)
EDU	-2.61 (0.2773)	-4.22 (0.0349)**	I(1)	-0.22 (0.927)	-5.02 (0.020)**	I(1)
EXR	-0.50 (0.980)	-4.59 (0.003)**	I(1)	-0.69 (0.967)	-4.56 (0.004)**	I(1)
INFL	-3.88 (0.021)**	-	I(0)	-3.16 (0.104)*	-14.06 (0.000)*	I(1)
MOT	-0.95 (0.940)	-6.35 (0.000)*	I(1)	-0.95 (0.940)	-6.35 (0.000)*	I(1)

RGDP	-0.26 (0.989)	-4.77 (0.002)*	I(1)	-0.41 (0.984)	-4.72 (0.002)*	I(1)
PGDP	0.01 (0.954)	-6.41 (0.000)*	I(1)	-0.18 (0.934)	-6.46 (0.000)*	I(1)

Note:

1. **** = 1%, ** = 5%, * = 10% significant level*
2. *() are probabilities values*
3. *For ADF test, automatic maximum lag based on Schwarz information criterion is applied while PP, the automatic maximum lag length based on Newey-West Bandwidth is applied*
4. *Where FPOP is fatality per population, FVEH is fatality per vehicle, EDU is secondary school enrolment, EXR is exchange rate, MOT is motorisation rate, INFL is inflation rate, RGDP is real gross domestic product and PGDP is per Capita Gross Domestic Product. Author's Computation 2019*

Having investigated the unit root of all the variables required for this model and has shown evidence of unit root of both order I (0) and I (I) (Tables 2 and 3), it is expedient to carry out co-integration tests to determine the long-run relationship for our ARDL model. Since the variables are found to be integrated of both order I (0) and I (I) as shown above from Augmented Dickey-Fuller and Phillips-Perron unit root test results. The study, therefore, employed the bounds testing approach to co-integration within the autoregressive distributed lag (ARDL) framework (Toda & Yamamoto, 1995) in Table 4 to investigate the existence of a long-run equilibrium relationship between the variables of interest.

Co-integration test

Table 4 highlights the result of the bound test for all the three models used for the study and critical values provided by Pesaran *et al.* (2001). The F-statistics is compared to the critical bounds at a different level of significance (1%, 5% and 10%) with unrestricted intercept and no trend. Specifically, the F-statistics of the three models ranged from 4.236 to 8.706, which was greater than the upper bound critical values at 1%, 5% and 10% respectively. The study rejects the null hypothesis of no long-run relationship among the variables. Hence, it fails to reject the alternate hypothesis of long-run equilibrium relationship among the variables.

Table 4: ARDL Bound Testing

	MODEL 1	MODEL 2	MODEL 3
F-STATISTIC	4.236	8.706	4.411
K	5	5	5
CRITICAL VALUES			
	I(0)	I(1)	
10%	2.08	3	
5%	2.39	3.38	
1%	3.06	4.15	

Source: Authors' Computation, 2019

Estimation results

Table 5 presents the causal relationship between Economic Growth, Motorisation and Road Traffic Safety in Nigeria using Autoregressive Distributed Lag (ARDL) technique. Three different models with each of Road Traffic Safety (Model 1), Economic Growth (Model 2) and Motorisation (Model 3) served as a dependent variable in the model. The first model in Table 5 was a measure of road safety and was introduced as the dependent variable. The results of the estimation show that in the short-run, economic growth had a negative effect on road traffic crash fatalities in Nigeria, while in the long run, economic growth had a positive effect on road traffic crash. The effect of economic growth on road safety was not significant in both the short run and long run. Motorisation, on the other hand, had a positive and significant effect on road safety in Nigeria. Similarly, education proxy by secondary school enrollment has a negative and significant effect on road traffic safety both in the short run and long run. This shows that an increase in education reduced road traffic crash in Nigeria. The coefficient of the error correction term (ECT) -0.145 implied that the model corrected its short-run disequilibrium by 15% speed of adjustment in order to return to long-run equilibrium.

Model 2 in Table 5 reveals the effect of motorisation and road traffic safety on economic growth in Nigeria. The result shows that road traffic crash reduces economic growth both in the short run and long run. The significant nature of road traffic fatalities also reveals the harmful effect of crashes and fatalities on the economy. In addition, motorisation had a negative but insignificant effect on economic growth in Nigeria, both in the short run and long run. Contrary to the effect of motorisation on economic growth, education had a positive and significant effect on economic growth both in the short and long run in Nigeria. This result shows that investment in human capital led to an improvement in economic growth. The error correction term shows that the model corrected its short disequilibrium by 39% annually.

Lastly, the effect of road traffic safety and economic growth on motorization is presented in model 3 of Table 5. The result in Table 5 shows that road traffic crash reduced motorisation in Nigeria in both the short and long run. The significant nature of the effect of a road traffic crash in Nigeria reveals that crashes and fatalities reduced the number of vehicles on the road. Economic growth, on the other hand, had positive and significant effect on motorisation in the short run, but in the long run, the effect was not significant and this align with the results of Al-Reesis *et al.*, (2013). This implies that an increase in income could lead to more people buying vehicle, thereby leading to an increase in motorization in Nigeria. However, in the long run people placed their additional income on other interest earning assets. The speed of adjustment in the model showed that distortions or shocks to the relationship would be corrected 10.3% annually before returning to equilibrium.

Diagnostic statistics are also presented. The Lagrange Multiplier (LM) tests for the presence of ARCH disturbances in the models are presented in Table 5. The LM test showed that the null hypothesis for no ARCH errors could not be rejected ($p > 0.05$), indicating there should be no ARCH left in the standardized residuals of the model. Furthermore, the ARCH test used to test for the presence of heteroskedasticity in the residual could not reject the null hypothesis of no heteroskedasticity in the models since the probabilities values are greater than 0.05. The Ramsey Regression Specification Error Test (RESET) for the models is also presented in Table 5. Under RESET, the null hypothesis that the model was the correct specification of the model was linear and tested against the alternative hypothesis that the correct specification of the model was non-linear. From Table 5, the result did not reject the null hypothesis that the original estimated linear form was the correct specification of the model. Furthermore, Figures 1, 2 and 3 show the plot of CUSUMsq of all the models. The CUSUMsq confirmed the presence of long-run association among variables as well as stability of the coefficients in the models, the models were stable since the line fell within the boundary.

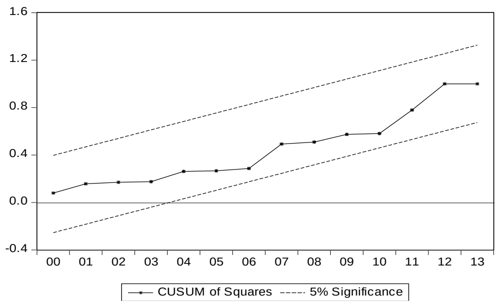
Table 5: Relationship among Fatality, Economic Growth and Motorization

Variable	Model 1: Dependent variable: Fatality (FPOP)	Model 2: Dependent variable: Economic Growth (RGDP)	Model 3: Dependent variable: Motorization (MOT)
		Short Run Relationship	
D(FPOP)		-0.951***	-0.473***
		[-16.707]	[-10.103]
		(0.000)	(0.000)
D(RGDP)	-0.005		0.049***
	[-0.237]		[3.382]
	(0.807)		(0.002)
D(MOT)	0.016*	-0.108	
	[1.716]	[1.539]	
	(0.095)	(0.133)	
D(EXR)	-0.006	-0.115	-0.085
	[-1.235]	[-1.624]	[-1.295]
	(0.224)	(0.114)	(0.204)
D(EDU)	-0.050**	0.2590***	0.0401
	[-2.389]	[16.497]	[0.294]
	(0.023)	(0.000)	(0.770)
D(INFL)	0.007	-0.101	-0.032
	[0.605]	[-1.317]	[-0.524]
	(0.548)	(0.197)	(0.604)
CointEq(-1)	-0.148**	-0.391***	-0.103**
	[-2.151]	[-16.996]	[-3.074]
	(0.038)	(0.000)	(0.003)
		Long Run Relationship	
FPOP		-0.683*	-4.575***
		[-1.754]	[-8.231]
		(0.088)	(0.000)
RGDP	0.034		0.471
	[0.238]		[0.346]
	(0.813)		(1.732)
MOT	0.110***	-0.078	
	[12.632]	[-1.530]	
	(0.000)	(0.136)	
EXR	-0.042	0.070**	0.496
	[-1.415]	[2.347]	[1.471]
	(0.166)	(0.025)	(0.150)
EDU	-0.339***	0.186*	0.388
	[-14.688]	[1.715]	[0.278]
	(0.0000)	(0.095)	(0.782)
INFL	-0.101	0.010	-0.305
	[-1.212]	[0.176]	[-0.523]
	(0.233)	(0.861)	(0.600)
C	17.422***	11.658**	16.817
	[3.738]	2.513]	[0.899]
	(0.001)	(0.017)	(0.316)
		Diagnostic Tests	
Serial Correlation LM	1.433 (0.256)	0.031 (0.984)	1.145 (0.324)

Heteroskedasticity Test	1.005 (0.326)	0.899 (0.454)	0.763 (0.487)
Ramsey RESET Test	1.784 (0.214)	0.222 (0.778)	0.433 (0.674)

Note:

(1) **** = 1%, ** = 5%, * = 10% significant level*
(2) *[ ] are t-value and ( ) are probability values*
(3) *Where FPOP is fatality per population, EDU is secondary school enrolment, EXR is exchange rate, INFL is inflation rate, MOT is motorization, RGDP is real gross domestic product and PGDP is per Capita Gross Domestic Product. Authors' Computation 2019*



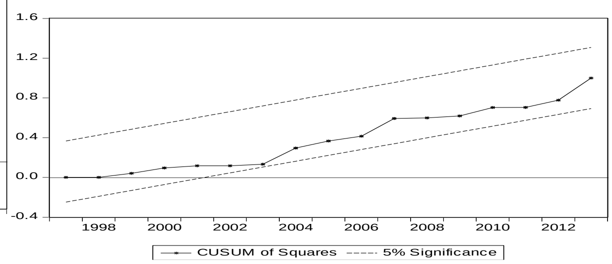


Figure 1: Stability Test for Model 1 Figure 2 Stability Test for Model 2

Source: Authors' Computation, 2019

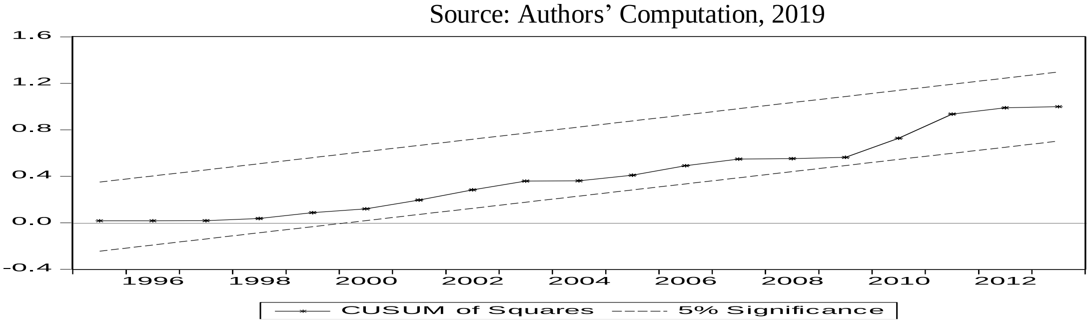


Figure 3 Stability Test for Model 3

Source: Author's Computation, 2019

Feedback effects among fatality, economic growth and motorization

Table 6 presented the joint short run and long run causality among road traffic safety, economic growth and motorization in Nigeria. The ARDL result in Table 6A shows the weak causality among the variables of concern. The Table shows that there was no long run causality between road traffic safety and economic growth in Nigeria. Indicating the important role of motorisation as an intervening variable between growth and road traffic fatalities. Furthermore, the result demonstrates a unidirectional relationship between motorisation and road traffic crash. The direction of causality run from road traffic safety to motorization. Similarly, unidirectional feedback existed between motorisation and economic growth in Nigeria. Economic growth granger causes motorisation.

Table 6A Feedback Effects among Fatality, Economic Growth and Motorization

VEC Granger Causality/Block Exogeneity Wald Tests

Excluded	Chi-sq	Df	Prob.
Dependent variable: D(FPOP)			
D(GDP)	3.891	8	0.867
D(MOT)	3.490	8	0.900
All	7.045	16	0.972
Dependent variable: D(GDP)			
Excluded	Chi-sq	Df	Prob.
D(FPOP)	4.095	8	0.848
D(MOT)	3.266	8	0.917
All	7.512	16	0.962
Dependent variable: D(MOT)			
Excluded	Chi-sq	Df	Prob.
D(FPOP)	21.758	8	0.005
D(GDP)	79.744	8	0.000
All	105.525	16	0.000

Source: Authors, 2019

Table 6B Joint Short Run and Long Run Causality (Strong Causality)

	Model 1: Dependent variable: Fatality (FPOP)	Model 2: Dependent variable: Economic Growth (RGDP)	Model 3: Dependent variable: Motorization (MOT)
D(FPOP), Ect (-1)	-	0.512 (0.857)	2.720 (0.005)**
D(RGDP),Ect(-1)	0.4864 (0.8421)	-	9.968 (0.000)***
D(MOT), Ect (-1)	0.436 (0.922)	0.436 (0.936)	-
D(EXR), Ect (-1)	0.547 (0.960)	0.470 (0.962)	3.300 (0.059)*
D(EDU), Ect (-1)	0.440 (0.972)	0.340 (0.973)	0.5348 (0.965)
D(INFL), Ect (-1)	0.7085 (0.505)	0.1147 (0.983)	0.276 (0.975)

**** = 1%, ** = 5%, * = 10% significant level*

Note: the coefficients are F-statisitcs and ( ) are probabilities values

Source: Author, 2019

Conclusion

The study investigated the dynamic interactions of economic growth, motorisation and road traffic safety in Nigeria. To achieved this, the economic growth was proxy with per capita income. Motorization was captured using vehicle in use/no of registered vehicles per 1000 of the population and traffic safety was captured by fatality per 100,000 of the population. Apart from these fundamental variables, control variables such as education proxy by secondary school enrolment, Inflation and exchange proxy by exchange of naira to US dollar were also introduced. The study revealed that, there exist a dynamic interaction of economic growth, motorisation and road traffic safety. Economics growth increases motorization and increasing motorization is capable of threating road traffic safety in the country. The implies that economic growth mainly contribute to increasing motorization. On the other hand, poor road traffic safety has negative impact on economic growth. Most importantly, drivers' education geared towards changing of attitudes and orientation can reduce road traffic crash fatalities in Nigeria.

The study therefore recommends that increasing level of education and regular orientation of drivers by relevant government agencies should be encouraged especially during economic boom. Also, government should endeavor to provide reliable public transportation as a way to stem unnecessary unincreased motorization in the country.

References

Adekunle, J. A. (2010). Road Traffic Accident, deaths and socio-economic development in Nigeria. *International Journal of Business and Social Sciences* 1(5): 47 –60.

Ageli M. M., & Zaidan A. M. (2013). Road Traffic in Saudi Arabia: An ARDL Approach and Multivariate Granger Causality. *International Journal of Economics and Finance, 5(7*), 26-31 doi:10.5539/ijef.v5n7p26

Al-Reesi H, Ganguly SS, Al-Adawi S, Laflamme L, Hasselberg M, & Al-Maniri A. (2013). Economic growth, motorization, and road traffic injuries in the Sultanate of Oman, *Traffic Inj Prev.* 14(3):322–8.

Arosantin, G.T. (2001). *Economic Impact Assessment of Road Traffic Casulties in Nigeria*. Unpublished PhD Thesis Obafemi Awolowo University Ile-Ife, Nigeria

Bener, A., Yousif, A., Al-Malki, M. A., El-Jack, I. & Bener, M. (2011). Is Road TrafficFatalities Affected by Economic Growth and Urbanization Development? *Advances in Transportation Studies an international Journal* Section B 23

Bener, A. & Ofosu J. B. (1991). Road traffic fatalities in Saudi Arabia. *Journal of International Association of Traffic and Safety Sciences (IATSS), 15,* 35 - 38.

Bishai, D., Quresh, A., James, P. & Ghaffar, A. (2006). National Road Casualties and Economic Development. *Health Economics,* 15, 65-81.

Blomquist, G., 1979. Value of Life Saving: Implications of Consumption Activity. *Journal of Political Economy,* 87(31), 540-558.

Borsos A. (2011). Long-term Safety Trends Related to Vehicle Ownership in 26 Countries. Fulbright Grant

Bougueroua, M. & Carnis, L. (2016). Economic development, morbidity and traffic accident in Algeria. *Accident Analysis and Prevention,* 92 168–174

CBN (2003). *Central Bank of Nigeria Annual Publication*

Constant A., Salmi, L. R., Lafont S., Chiron M. & Lagarde E. (2008). The Recent Dramatic Decline in Road Fatality in France: How Drivers' attitudes Towards

Dargay J., Gately D., & Sommer M. (2007). Vehicle ownership and income growth, worldwide: 1960–2030. *Energy J (Camb Mass),* 28:143-70.

Engle, R. F., & Granger, C. W. J. (1987). Cointegration and error correction: Representation, estimation and testing, *Econometrica,* 251-276.

Enu, P. (2014). Road traffic accidents and macroeconomic conditions in Ghana. *Social and Basic Sciences Research Review,* 2(9), 374-393.

Friedman, Milton (1957). The permanent income hypothesis. *A Princeton University Press*.

Hamed, A, Shyam, S. G.., Samir, A., Lucie, L., Marie, H., & Abdullah, A. (2012). Economic growth, motorization, and road traffic injuries in the sultanate of Oman, *Traffic Injury Prevention,* 14:322–328

Harper S., Charters T.J., & Strumpf E.C., (2015). Trends in socioeconomic inequalities in motor vehicle accident deaths in the United States. *Am J Epidemiol,* (7):606-14.

He H., Paichadze N., Hyder A. A., & Bishai D. (2015). Economic development and road traffic fatalities in Russia: Analysis of federal regions. *Injury Epidemiology* 2:19 DOI 10.1186/s40621-015-0051-6

Iacono M. , & Levinson D. (2016). Mutual causality in road network growth and economic development. *Transport Policy,* 45: 209–217

Ighodaro, C.A.U. (2008). Transport infrastructure and economic growth in Nigeria. Revised Paper Submitted for Presentation at the First International Conference on Transport Infrastructure (ICTI 2008), Beijing, China.

Kopits, E. & Cropper, M. (2005). Traffic fatalities and economic growth. *Accident Analysis and Prevention*, 37(1): 169-178.

Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics,* 22:3-42.

Ohakwe, J. , Iwueze, I.S., & Chikezie, D.C. (2011). Analysis of road traffic accidents in Nigeria: A Case Study of Obinze/Nekede/Iheagwa Road in Imo State, Southeastern, Nigeria. *Asian Journal of Applied Sciences, 4: 166-175.*

Oluwaseyi, J. A., & Gbadamosi, K. (2017). Road traffic crashes in Nigeria: Causes and Consequences. *Transport & Logistics*, *17*(42).

Onyemaechi, N. O. C., & Ofoma, U. R. (2016). The public health threat of road traffic accidents in Nigeria: A call to action. *Annals of medical and health sciences research*, *6*(4), 199-204.

Pesaran, M.H., Shin, Y., & Smith, R.J., (1996). *Testing for the existence of a long-run relationship.* Department of applied economics Working Paper no.9622. University of Cambridge, Cambridge.

Pesaran, M.H., Shin, Y., & Smith, R.J., (2001). Bounds testing approaches to the analysis of level relationships. *J. Appl. Econ,* 16: 289–326.

Pesaran, H., & Pesaran, B., (2009). *Time series econometrics using Microfit 5.*Oxford University Press, Oxford.

Pesanran, M. H. & Shin, Y. (1998). An autoregressive distributed-lag modelling approach to cointegration analysis. *Econom Soc Monogor,* 31: 371-413

Peltzman, S. (1975). The Effects of automobile safety regulation. *Journal of political economy,* 4(83): 677–725.

Pratte, D. (1998). Road to ruin: road traffic accident in the developing world, Nexus, 13: 46-62

Rezaei S, Lankarani K. B., Matin B. K., Bazyar M., Hamzeh B., & Najafi F. (2015). Determinant of road traffic crash fatalities in Iran: A Longitudinal Econometric Analysis *JRHS* 2015; 15(3): 163-1

Romer, P. (1986). Increasing returns and long-run growth. *Journal of Political Economy,* 94(5):1002-1037.

Romer, P. M. (1986), Increasing Returns and Long-Run Growth. *Journal of Political Economy,* 94(5): 1002−1037.

Shalini, R. T. (2009). Economic cost of occupational accidents: Evidence from a small island economy. Safety Science, 47, 973-979.

Soderland, N. & Zwi, A.B. (1995). Traffic-Related Fatality in Industrialized and Less Developed Countries. *Bulletin of the World Health Organization*, 73(2): 175-182.

Wiebe, D. J., Ray, S., Maswabi, T. Kgathi, C., & Branas, C. C. (2016). Economic Development and Road Traffic Fatalities in two Neighbouring African Nations. *African Journal of Emergency Medicine,* 6: 80–86.

WHO (2013). World Report on Road Rraffic Injury Prevention. *World Health Organization,* GenevaGoogle Scholar

WHO (1984). Road traffic accidents in developing countries WHO TRS 703 World Health Organization (1989) Analysis of Achievements of Traffic Safety in Industrialized and Developed Countries.

Wilde, G. & Simonet, S. (1996) Economic fluctuations and the traffic accident rate in Switzerland; a longitudinal approach.

Yannis G., Papadimitriou E. & Folla K., (2014). Effect of GDP changes on road traffic fatalities. *Safety Science 63*, 42-49

Yusuff, M.A. (2015) Impact assessment of road traffic accident on Nigerian economy. *Journal of research in Humanities and Social Science.* 3(12): 8-1