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Analysis of Fare Structure and Determination of Bus Operation in Nigerian Cities

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One of the challenging issues in the provision and management of urban transport service in developing countries is the affordability. Due to ineffective regulations, poor enforcement of operational standards, inefficient management practices and low level of technological base, the provision of urban transport services are highly unorganised in many developing countries in Africa particularly in Nigeria. This unorganised nature of urban transport operation has caused undue high cost of public transportation in Nigerian cities because exorbitant transport fares are usually charged by the bus operators. The high cost of transport fares compels urban residents to spend a large portion of their income on mobility with its attendant socioeconomic problems. This paper therefore attempts to analyze the structure and basis for charging public transport fares in Nigerian Cities. It tries to compare and contrast the fares charged by bus operators between and among cities as well as finding out any form of variation that may exist. The paper further highlights the socioeconomic implications of the current bus fare structure and determination and suggests the appropriate fare structure and determination that will enhance transport affordability of the urban poor.

Keywords: fare, structure, determination, transport, operation, routes, city, operators, cities and bus

Introduction

One of the main determinants of modal choice is the fare. All things being equal, the fare charged by transport operator can either hinder or attract the rate of service patronage especially among low income earners. The need to cover cost of transport operation and at the same time charge affordable fare is the main issue in fare determination. Fare is the money paid by passengers as a partial or full contribution to the operational cost of the transport system. The word 'fare' connotes the reward usually payable to transport operator/carrier for the carriage of goods and people (Ndikcom 2008).

It could be partial where government is involved in subsidizing part of the cost of the operation. Where there is no subsidy, the end users of the transport borne the total cost of the transport operation as well as profit margin of the operators. However, the need for subsidies has been argued severally (See Adeniji, 1987).

Fare structure therefore is the system set up to determine how much is to be paid by various passengers of a transit vehicle at any given time (Wikipedia the free Encyclopedia, 2013). In other words, fare structure refers to the categorization of fares charged by operator of transport service. Fare structure has been classified in a variety of ways. For instance, fare structure has been classified based on relationship between the amount of fare and distance travelled. According to this criterion, fare structures are flat or differentiated. The differentiated fare can be further subdivided -into zonal fare, distance-based fare, sectional fare, and time-based fare (Feng-Ming, 2012 and Vuchic, 2004). On the other hands, other scholars classified fare into five namely; kilometre/mile-graduated fare, kilometre with taper fare, flat fare, zonal fare and time-dependent fare (Iles, 2005).

It has been also observed that public transport fare is central to solving the problem of public transport affordability (Slobodan and Rubin, 2005). Since the public transport fare is major determinant of transport affordability index; research efforts should therefore be intensified in the area of fare structure determination and collection methods. This is necessary because the more affordable is the public transport fare the less is the percentage of household expenditure on transport.

Apart from the effects of fare on the level of patronage, the multiplying effects are quite numerous. Its effects may be seen in the rate of urban travel, access to job and other social and economic services as well as on the level of poverty. Provision of affordable transport service could therefore go a long way to help in reducing poverty level in cities.

The main objective of this paper is to model city bus fare determinants in Nigerian in order to establish a basis for bus fare forecasting in Nigerian cities. To achieve this objective, the

paper analyses the public transport fare structure and determination, it tries to compare and contrast the fare charged between and among cities as well as finding out any form of variation that may exist. Finally, the paper highlights some policy implications of the current fare structure and determination on urban economy and recommends some policy actions towards promoting public transport affordability and mobility in Nigerian Cities.

The Study Cities

The cities where this study was conducted are Zaria, Kano and Minna. They are located in the North Central and North Western parts of Nigeria. Figure 1 shows the map of Nigeria and the location of the three study cities. Zaria can be described as one the ancient cities in the Northern Nigeria with an estimated population of 975,153 (GeoNames geographical database, 2014). It is the second largest city in Kaduna State; an important State in the North western Nigeria. The city of Zaria is the home of the renowned Ahmadu Bello University; (the first university in the Northern Nigeria), many research and educational institutions as well as military formations. Figure 2 shows the city map and the bus routes in Zaria. The second study city is Minna, it is the administrative capital city of Niger State. The City by 2007 census figure has an estimated population of 304,113 and characterized with many administrative, economic, social and political activities. Figure 3 shows Minna city map.

The third city where this study was carried out is Kano. Kano is known to be the second largest city in Nigeria after Lagos. According to the 2006 population census, (NPC) the population of Kano is estimated at 3,848,885. The city is the commercial and industrial centre of the Northern Nigeria. It is therefore considered as one the most strategic cities in Nigeria. With huge population and wide geographical areas as well as varieties of socio-economic activities in these cities, the demand for transport is very high. Figure 4 shows the city map of Kano.

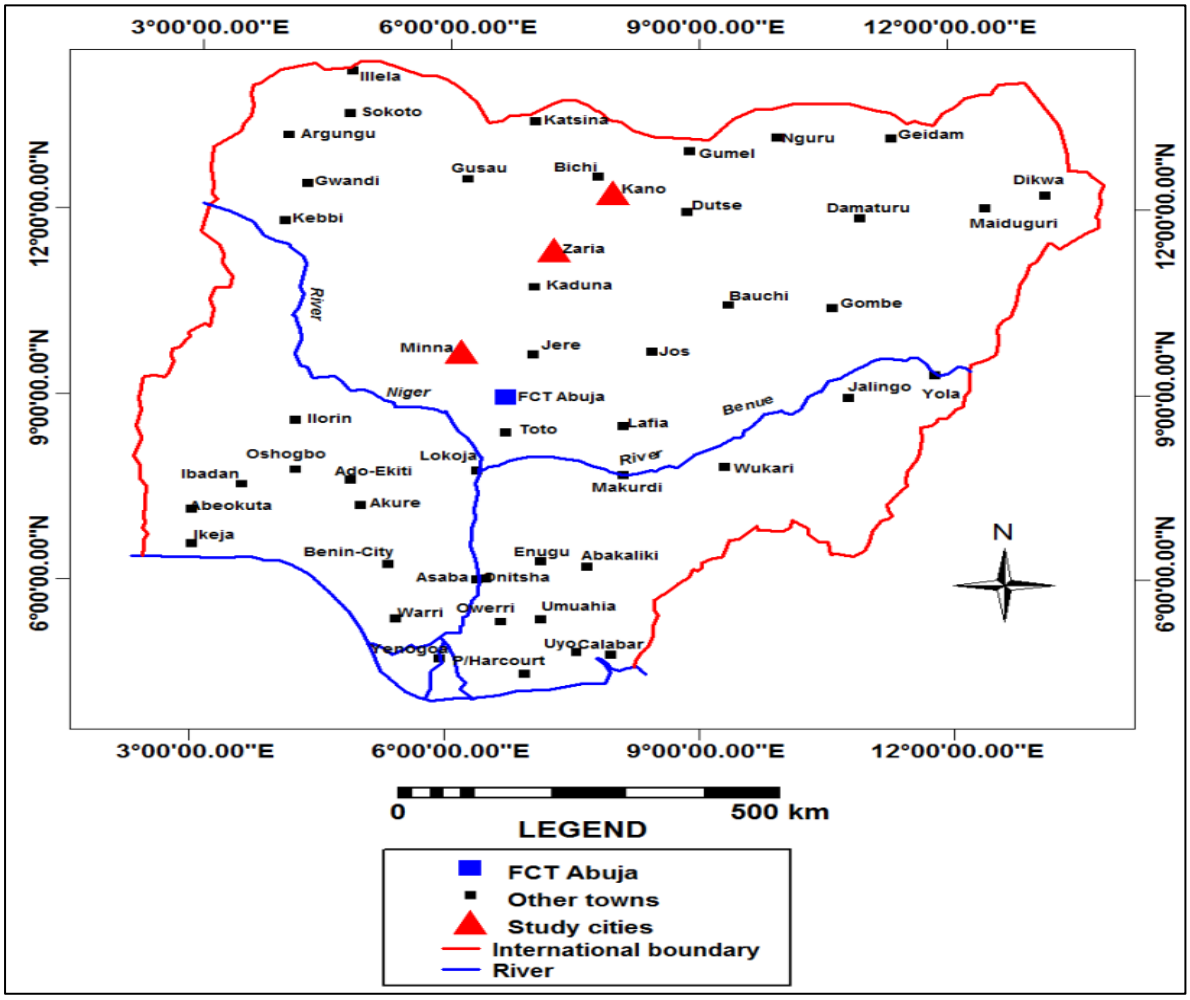


Figure 1: Nigeria Map showing the Study Cities

Methodology

The data used for this study were mainly collected from the primary sources. Prior to the actual data collection, preliminary survey was first conducted to identify the number and location of bus routes and pre-test the data instrument designed for the study. About 10 copies of the data instruments were administered in Zaria City to test the adequacy of the instrument in relation to the objective of the study. This pre-test analysis enables the researcher to fine tune the structured questionnaire used for the study.

In carrying out the main questionnaire survey, a sample size of 50% of bus routes in Kano, 100% in Zaria and 80% in Minna were selected randomly for the study. The population under study is bus operators. A structured questionnaire was designed to elicit required information from bus operators in the three cities at the main bus terminals of the selected routes. The questionnaire contained closed ended questions in which respondents were asked to choose options applicable to them. Out of four variables extracted from questionnaires and used for the analysis, three of them (i.e. route length, bus capacity and journey time) were measured using ratio scale while the fourth variable (i.e. availability of government subsidy) was measured using nominal scale.

Through transport operators' Union's records, 560 bus operators were found in all the selected routes in Kano, 230 bus operators in Zaria and 330 operators in Minna. The questionnaires were administered on the bus operators face to face through the aid of research assistants. A sum of 50 questionnaires were successfully administered in Kano, 30 in Minna and 25 in Zaria making a total of 105 questionnaires but only about 93 of them were used for the analysis. Research assistants were also engaged to board some of the commercial buses along the surveyed routes to observe and record the travel times for each route. The questionnaire was structured into four sections; the first section concerns with general information such as name of city, route name, time and date of survey while the second section deals with data on the types and the carrying capacity of bus used for operation. The third section has about eight set of questions which include the factors considered in charging fares, with six options in which respondents were asked to choose. This section also contains questions on fare differential between peak and off peak periods, the fare policy decision makers, availability of government subsidy and type of subsidy enjoyed by the bus operators, and the factors that influence bus fare regime. Each of these questions is designed with relevant options in which respondents were asked to choose. The fourth section of the questionnaire on the other hand has to do with route data, which include route distance, average journey time from the first bus stop to the last, minimum and maximum fare charged on each route.

In addition to the questionnaire survey, a direct measurement of each study route using a vehicle odometer by driving through the study routes to determine the distances from the first bus stop to the last was carried out. The data collected were analyzed both using correlation analysis and multiple linear regression techniques.

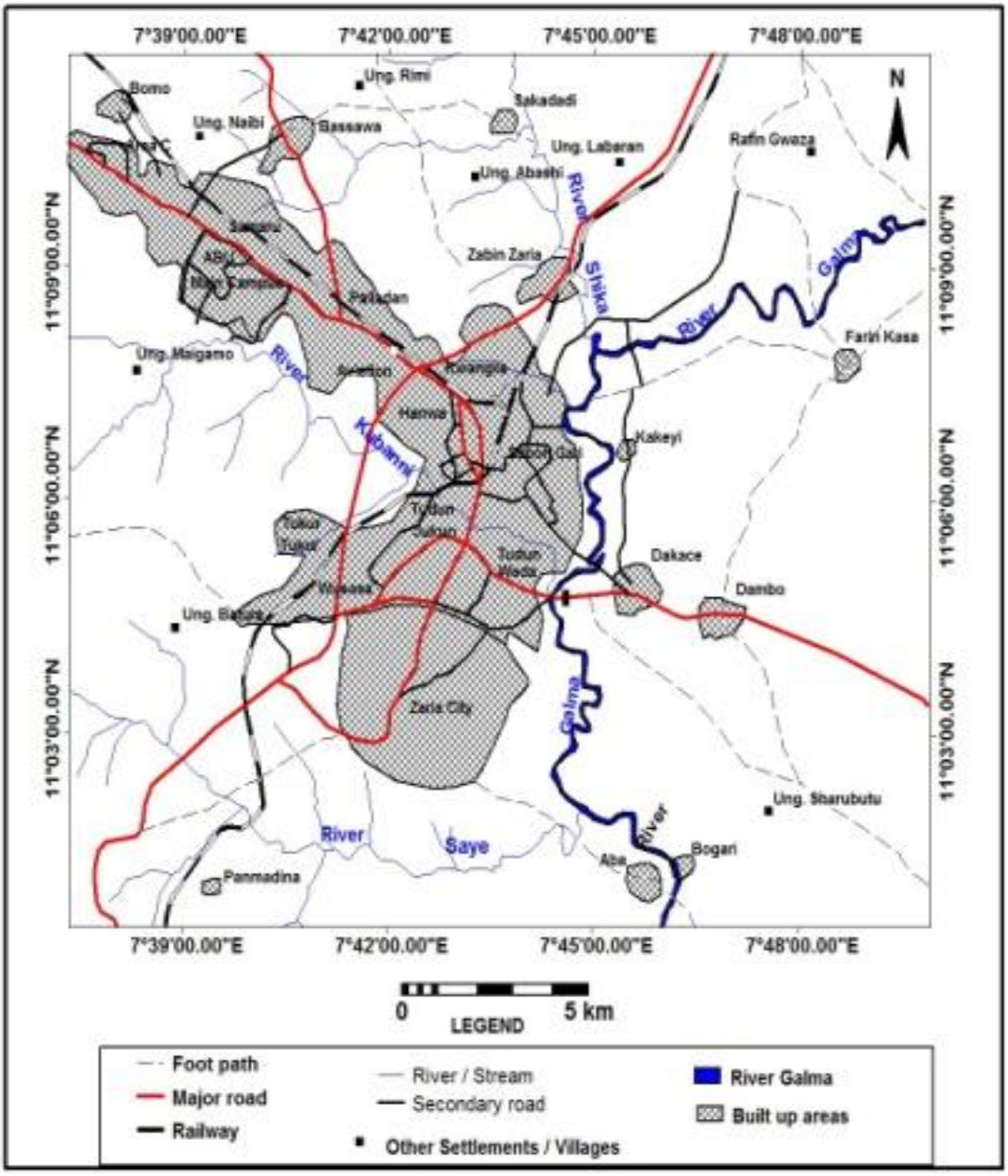
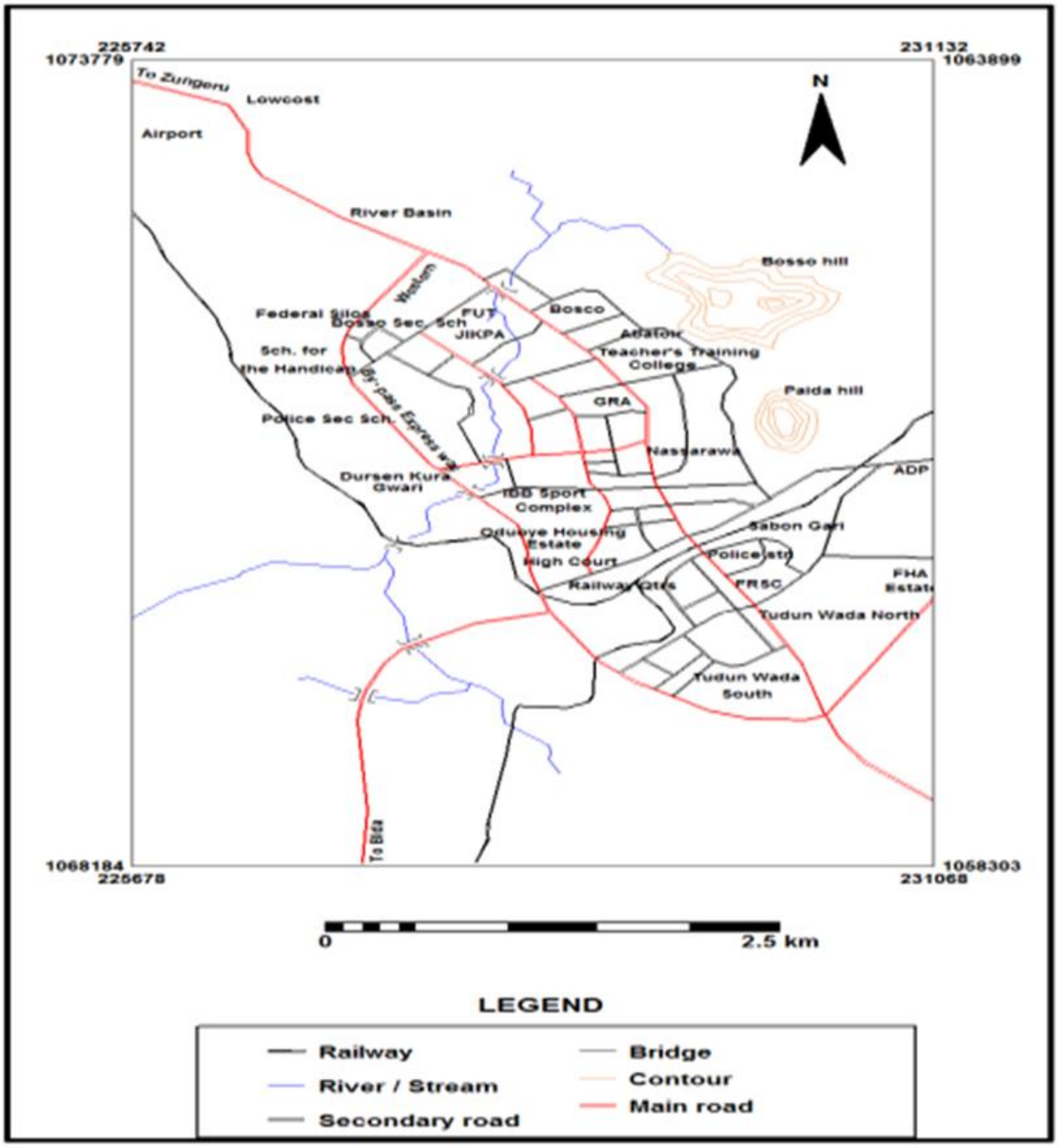


Figure 2: Map of Zaria Township showing bus routes



Bus Transport Operation in Nigeria

The operation of urban or city transport in Nigeria is mainly undertaken by private operators. In fact, between 95 and 98% of public transport services in cities like Lagos, Ibadan, Port Harcourt, Kano, Minna, Zaria e.t.c. are provided by the private operators (World Bank, 1990, Adeyemo, 1996 and Aderamo, 2010). In some few cities like Minna, Kano and Abuja, buses are provided by the state governments to the private transport operators either on loan or hired purchase, but the actual operation is undertaken by the private operators.

Figure 4 Showing Kano City map

Nigerian cities are characterized by low level of car ownership. In these cities, there is an average of 4 cars per 1000 population which translates to about 0.004 car owned per person (Adesanya, 2011). This low level of car ownership leads to high dependence on public transportation which in most cases is grossly inadequate and inefficient. The major means of public transportation in cities in Nigeria is bus. Bus operation alone accounts for about 90% of public transport services in Nigerian cities the remaining 10% is shared between Taxis, motorcycles, tricycles and walking. Other modes of public transport such as rail services are not available presently in many Nigerian cities with the exception of Lagos and Kaduna where limited and erratic services are offered. In other cities where rail services are available they are only used for intercity travels.

Bus of different sizes are assigned to ply major city routes with little or no regulations in terms of operational standards, fare charging, fare structure and determination. The only known fare and routing regulator is the trade union that is known as National Union of Road Transport Workers (NURTW). This Union regulates and controls the activities of their members who provide over 95% of bus services in cities (NURTW, 2014). This is contrary to what is obtainable in many developed countries where regulation and control of public transport services are done by the government. The absence of government regulation accounts for the chaotic and unorganized nature of public transport system experienced in Nigerian cities.

Fare Structure and Policy of Bus Operation in Nigerian Cities

Analysis of fare structure of bus operation in the study cities shows that only two types of fare structure can be identified. Table 1 shows the results of the analysis. In Kano, 95% of the operators used zonal fare while 5% used flat fare structure, in Minna 78% used zonal fare while 21.4% used flat fare whereas in Zaria, only zonal fare structure exists.

Table 1 Fare Structure of Bus Operation

		Fare Structure of Bus Operation					
CITY		DGF	ZF	FF	TOBF	JTBF	Total
Kano	No of Resp.	0	45	5	0	0	50
	% of Total	0%	95%	5%	0%	0%	100%
Minna	No of Resp	0	11	3	0	0	14
	% of Total	0%	78.6%	21.4%	0%	0%	100%
Zaria	No of Resp.	0	15	0	0	0	15
	% of Total	0%	100%	0%	0%	0%	100%

Keys to table 1; DGF means distance graduated fare, ZF means Zonal fare, FF means Flat fare, TOBF means Time of operation based Fare and JTBF means journey time based fare

Fare regime or policy has to do with principles and goals underlying and guiding bus operation pricing-related decision. In other words, it deals with underlying factors influencing bus operators in reviewing fare charged. A further investigation into factors that often influence fare regime or policy of bus operation in these cities reveals that fuel price constitutes the major factor that determines fare regime and policy, it accounts for 78%, of all factors identified. The next contributing factor is 'general inflationary trend' which accounts for 19.4%. Surprisingly, operational cost accounts for 2.2% of the factors influencing fare regime and policy of bus operation in Nigerian cities.

Generally, bus operation in Nigeria is dominated by informal and unorganized operators who do not have any formal professional training in bus operation. They are mainly illiterate or semi- illiterate people whose knowledge of economics and business principles and practice is limited. Bus fare is often reviewed by the operators whenever there is increase in the price of fuel particularly Petroleum Motor Spirit (PMS) in Nigeria. Fuel pricing has been a volatile issue in Nigeria, any increase in fuel prices often result in civil unrest as it often causes general increase in the prices of other goods and services in the economy of Nigeria.

Fare Determination of Bus Operation

Fare determination of bus operation is also analyzed to determine the rate of fare charged per passenger per kilometre and also model bus fare determinants in Nigerian cities. Table 2 shows the average fare charged per passenger per kilometre in each study city. The table shows that there are variations in the fares charged in three cities. As can be seen from this table, the biggest city (Kano) records the least fare per passenger per kilometre of 7.56 naira (₦) while the smallest city (Minna) records the highest fare per passenger per kilometre of ₦16.71. It seems the bigger the city, the lower is the bus fare charged per passenger per kilometre. The last column in table 2 shows the equivalence of the average fare charged per passenger per kilometre in US dollars using the exchange rate of 155.74 naira to one (1) US dollar, (CBN, 2014). In a country with a national minimum wage of only 123.50 dollars per month, this can be considered very high!

Table 2 Average fare charged per Kilometre

	Average Fare Charged Per Passenger Per Kilometre			Us Dollar
City	Lowest Fare in naira (₦)	Highest Fare in naira (₦)	Average Fare in naira (₦)	Average Fare in Us Dollar ($)
Kano	*5.48*	*9.64*	*7.56*	*1.2 cents*
Minna	*12.08*	*21.34*	*16.71*	*9.4 cents*
Zaria	*2.29*	*8.43*	*5.36*	*3 cents*

Modelling Bus Fare determinants

An attempt is made also to estimate the fare determinants of Bus operation in Nigerian cities using multiple regression models. The multiple regression models have been used severally in the literature to estimate degree of fitness and also forecast and determine the relationship between dependent variable and a number of independent variables. It can therefore be conceptualised that there is a set of variables x_1, x_2, x_3-----x_n which can be used to explain the amount of fare charged by bus operators in Nigerian cities.

This can be expressed mathematically as

$$Y = f(x1, x2, x3, xn) \quad (1)$$

As a result, equation can be written using multiple regression equation thus;

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_nx_n + e \quad (2)$$

Where $Y =$ the dependent variable

a = constant

b_1, b_2, b_3------b_n = the intercept

x_1, x_2, x_3, ------- x_n = the dependent variables

e = error term (unexplained variables)

In this study, the dependent variable (Y) is the fare charged per passenger per route by the operators of bus on different routes denoted as (F) which is measured in Naira (Naira is the Nigeria's national currency). The following have been identified as independent variables;

x_1 = the route length measured in kilometers denoted by (RL)

x_2 = type of bus, measured by its carrying capacity denoted as (TB)

x_3 = journey time, measured by the average travel time on the surveyed bus routes denoted as (T) and

x_4 = availability of government subsidy to the bus operators denoted as (GS)

The above variables are hereby operationalised as;

$$F = a + b_1\mathrm{RL}_1 + b_2\mathrm{TL}_2 + b_3\mathrm{JT}_3 + b_4\mathrm{GS}_4 + e \quad (3)$$

The first aspect of this analysis is the correlation analysis which is presented in Table 3. The table shows how both dependent and independent

variables are related to each other. The table shows that fare charged is highly and positively correlated to the Route Length (RL) with coefficient of (0.776). This implies that increase in route length causes increase in the fare charged. The second remarkable observation is that fare charged is negatively correlated to vehicle capacity with value (-0.292), which implies that increase in vehicle capacity causes reduction in the fare charged.

Table 3 Correlation matrix of Dependent and Independent Variables

Correlations						
Pearson Correlation		F	R_L	VC	JT	GS
	Fare	1.000				
	Route_Lenght	.776	1.000			
	Vehicle_Capacity	-.292	-.311	1.000		
	Journey_Time	.455	.697	-.152	1.000	
	Govt_Subsidy	-.134	-.405	.158	-.306	1.000

Source: Regression Out-put, March 2014

Key to the table3: F means fare, RL means Route length, VC means Vehicle capacity, JT means Journey time and GS means Government subsidy

The fare charged is also positively correlated to journey time with value (0.455), which also means increase in journey time causes increase in the fare charged on the bus route. Fare charged is also found to be negatively correlated to government subsidy with value of (-0.134) which implies that increase in government subsidy causes reduction in fare charged.

Table 4 Regression Coefficients

Coefficients[a]								
	Unstandardized Coefficients		Standardized Coefficients			Sig.	Collinearity Statistics	
Model	B	Std. Error	Beta	T			B	Std. Error
Constant (a)	23.331	12.462		1.872	.065	23.331	12.462	
RL	8.172	.860	.951	9.499	.000	8.172	.860	.951
VC	-.626	.826	-.053	-.759	.450	-.626	.826	-.053
JT	-.178	.111	-.150	-1.613	.111	-.178	.111	-.150
GS	13.317	4.532	.214	2.938	.004	13.317	4.532	.214
Dependent Variable Fare								

Key to table 5: RL means Route length, VC means Vehicle capacity, JT means Journey time and GS means Government subsidy

Table 4 shows the regression coefficient of four independent variables and their level of significance. It shows the regression coefficient for the independent variables and the constant term in the second column labelled "B". The column shows a constant term (a) of 23.331, RL is 8.172, VC is -.626, JT is -.178 and GS records 13.317.

A close examination of the level of significance in column 6 on table 4 reveals that Route Length and Government Subsidy are found to be positively significant with P- value of (0.000) and (0.004) at 5% significant level respectively because their P- values are less than 0.05. We can claim that the fare charged by bus operators is positively related to the route length and government subsidy. The other two variables, that is vehicle capacity and journey time are not found significant with their P- value of (0.450) and (0.111) respectively at 5% significant level.

The least squares equation for predicting fare charged will be fare = 23.331+ 8.172 (Route Length) + 13.317 (Government Subsidy).

Table 5 Regression Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.810[a]	.656	.639	18.834

Table 5 above shows that 'R' square of the two independent variables (i.e. route length and

government subsidy) considered to be significant at 5% significant level is 0.656. In other words, the independent variables (i.e. route length and government subsidy) account for 65.5% of the variance in the dependent variables (i.e. bus fare). The value is high enough hence, the model can be considered good enough for bus fare determination in the study cities.

Recommendations

The study has revealed the underlying factors of bus fare structure and determination in Nigerian cities using Zaria, Minna and Kano as case studies. From the findings the following policy are hereby outlined;

- It becomes necessary that the Nigerian Governments both at federal and state levels should continue to provide subsidy for bus operation in Nigerian cities, this no doubt from the above finding will help to reduce fare charged by bus operators. Reduction in fare will go a long way to reduce the cost of public transportation thereby enhancing public transport affordability.
- Bus operators need to improve on their fare structural system. Apart from flat and zonal structures currently existing, there is the need to explore other fare options in order to make choice of fare by commuters more flexible.
- Since the length of route is a major determinant of fare in the study cities, efforts at improving city livability should focus on reducing long distant travel by creating satellite central business districts in different parts of the city. In addition, essential services and facilities that make people travel long distances within the city should be brought closer to the people. This will help to reduce daily commuting distances covered by city residents which will also help in reducing the cost of passenger transportation in Nigerian cities.
- A further research may be needed to be carried out to determine the level of public transport affordability among the city residents in Nigeria which was not covered in this study.

Conclusion

The study has provided useful information on bus fare structure and determination in Nigerian cities. The study has implications for public transport policy formulation and implementation. The results no doubt can help relevant authorities to predict the bus fare and determine how best to regulate urban transport fare in Nigerian Cities. The relevance of government subsidy as policy instrument for enhancing urban transport service provision is also confirmed in this study. The need for the use of high capacity buses as against the current use of small buses for urban transport services is also necessary as the findings reveal that the amount of fare charged is inversely related to the bus carrying capacity. Although, useful information is provided on bus fare structure, determination and modeling in some Nigerian cities, a further research is however required to determine the public transport affordability of city commuters in Nigeria as well the influence of cities' size on the bus fare. This is a new area of research the author will like to investigate in the nearest future.

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