Demand for Air Transport in Nigeria

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ABSTRACT The paper seeks to assess the demand for domestic air transport in Nigeria and the factors responsible for it. In particular, it looks at passenger, aircraft and freight traffic and the relative demand for them in the country. The methodology used involved collection of data on passenger, aircraft and cargo movements in Nigeria for the period 1975-2006 to determine the pattern of air travels. Data on macro and micro-economic variables considered to affect demand for air travel were also collected. Multiple regression method was then used to develop models of demand in respect of the three types of movement. The results show that, of the selected variables, Index of Agricultural Production, Index of Manufacturing Production, Gross Domestic Product, Inflationary Rate and Consumer Price Index are important in the explanation of the demand for air transport in Nigeria. The paper suggests that in order to encourage the demand for air travel in Nigeria, there is the need for government to improve the transportation system in the country.

INTRODUCTION

No transport organisation can operate profitably unless there is a demand for its services and the estimation of expected future demands is a key element in planning transport operations. In this age too where there is competition, it is appropriate to carry out demand analysis of an organisation's services. Transport is a service rarely in demand for its own characteristics. Demand for public transport, road freight facilities or airline services are usually derived from some other functions (Cole 1998). The demand level for transport is related directly to the demand level for the product or service. It is therefore essential for a transport organisation to establish a demand pattern for its services.

In Nigeria, the demand for air transport services has been on the increase within the past three decades. There has been growth in passenger, aircraft and freight traffic as a result of physical and economic development of cities in different parts of the country. The creation of states and the need to develop state capitals for them to perform their socio-economic responsibilities has fuelled the tempo of physical development in the country. Fast connections between the diverse economic spaces of Nigeria are better achieved through air transportation. According to Ogunbodede (2006), the diversity in the resource endowment between the North and the South is an important factor in the growth of air transport in Nigeria. Also, the new civilian administration regards the air transport subsector as a critical focal point in the effort to open up the country to foreign investors and thereby narrow the gap between available and required levels of domestic investment capital (Adeyemi 2001).

Although the air mode is recent in Nigeria when compared with the road and railway modes, its contribution to the development of transportation in Nigeria is very significant. For instance, domestic passenger traffic stood at 3,093,000 in 1988. It rose to 4,618,000 in 1998, and 6,424,000 in 2004 (Aderamo 2006a). Similarly, both cargo and mail transportation by air had been on regular demand (FMT 2004). All these are indications of increasing demand for air transport services in the country. In order to accommodate future demand for air transport services in Nigeria, it is expedient to plan for it. This will greatly assist the aviation industry. The long run success of any organisation is closely related to how well management is able to foresee the future and develop appropriate strategies. The objective of this study is to examine the demand pattern for air transport in Nigeria and show its implications for air transport planning.
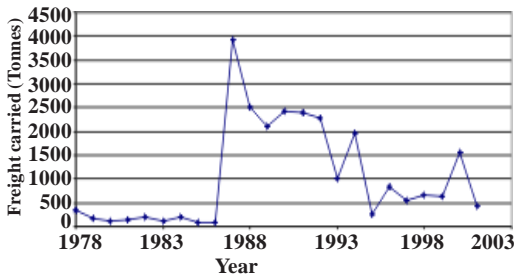
TREND IN AIR TRAFFIC IN NIGERIA

Air traffic in Nigeria comprises, of passenger traffic, aircraft movements, freight traffic and mail traffic. This study examines these different types of traffic. Figure 1 shows the trend in passenger traffic for the period 1975 – 2006. The pattern shows a fluctuating trend in passenger traffic with a value of 408,000 passengers in 1975 rising gradually to a peak of 1,894,000 in 1981 and decreasing sharply to about 89,000 passengers in 1995. The trend then continued to fluctu-

ate until it attained a value of approximately 2,800,000 passengers in 2006 (CBN 2006).
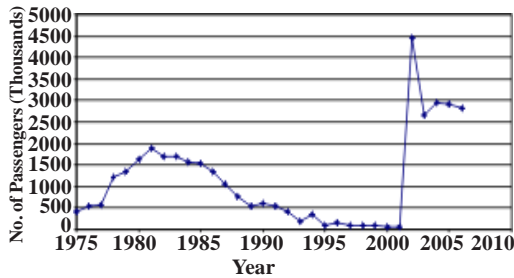
Fig. 1. Trend in passenger traffic
*Source:* CBN 2006

Figure 2 also shows freight traffic for the period 1978 – 2001. The trend also shows a fluctuating pattern with a value of approximately 350 tonnes of freight in 1978 which declined to about 133 tonnes in 1981. Thereafter, freight traffic began to fluctuate between about 200.00 tonnes in 1982 to 85 tonnes in 1986. It then rose to approximately 4,000 tonnes in 1987 after which it began to decline again until it reached a low ebb of 447 tonnes in 2001 (CBN 2006). The pattern of mail traffic (Fig. 3) is not substantially different as it had a value of 308 tonnes in 1978 which began to fall until it reached a value of 66 tonnes in 1986. Thereafter, it began to fluctuate between a value of 253,000 tonnes in 1987 and 91 tonnes in 1994. In 1995, it experienced an astronomical rise to about 1,400 tonnes and began to fluctuate again until it attained a low value of about 30 tonnes in 2006 (CBN 2006).

Fig. 2. Trend in freight traffic
Source: CBN 2006

The fluctuations in air traffic in Nigeria between 1975 and 1998 can be attributed to the changing economic climate of the country and the impact this has had on the transport sector (Aderamo 2006a). These are the oil boom pe-

riod of the early 70's and the Structural Adjustment Programme (SAP) of 1986. Management, logistics and underfunding problems also contributed to what domestic air transport experienced in Nigeria between 1995 and 1999. However, domestic airline operations have improved remarkably in recent times. Improved disposable income of the people particularly between 1999 and 2002, deregulation of the aviation industry that opens the sector to private participation and democratic governance have all stimulated demand for air transport (FMT 2004).
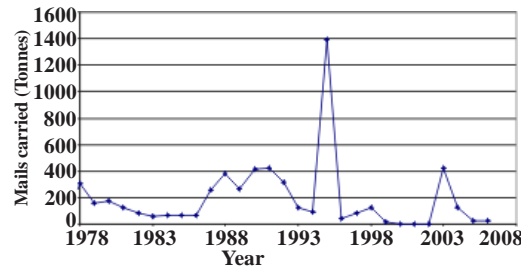
Fig. 3. Trend in mail traffic
Source: The Author

DEMAND FOR AIR TRANSPORT

The demand for transport is a function of certain variables or characteristics. Some of the distinguishing characteristics of public transport under local conditions can be in respect of speed, passenger income, safety, comfort and reliability or service frequency (Osayimvese and Filani 1974; Maunder 1982; Cole 1998; Banister 1998).

The overall trend of demand for air transport has been consistently increasing worldwide. In 1950s and 1960s, annual growth rates of 15% or more were common. Annual growth rate of 5-6% persisted through the 1980s and 1990s. Growth rates are not consistent in all regions but countries with a de-regulated airline industry have more competition and greater pricing freedom. This results in lower-fares and sometimes dramatic spurts in traffic growth. The U.S, Australia, Canada, Japan, Brazil, Mexico, India and other markets exhibit this trend (Smith 2002). The industry has been observed to be cyclical in its financial performance.

Besides, economic growth, higher disposable incomes and increased leisure time on the demand side, combined with falling real airline tariffs and technical change on the supply side, have been important driving forces behind the long-

term growth of international air transport (Michalski 1996).

Many statistical models exist for predicting the demand for air travel. Some of the models discussed in the literature include Box-Jenkins approach which is useful for modeling a time-series with seasonal components (Anderson 1976); market-share model which is based on estimating a proportion of the regional or national level of activity assigned to the local level, usually assumed to be a regular predictable quantity. In this method, the existence of a data source minimizes the cost of forecasting but it neglects abnormal growth factors at the local level (Uddin et al. 1986).

Judgmental forecasting has also been used as a subjective approach that uses a panel of executives or industry experts rather than a single estimator. The method, however, lacks any statistical measure (Moutinho et al. 1998). Some other methods are the sales-force estimates approach whereby sales personnel who are in direct contact with customers are considered to be in the best position to estimate likely short-term sales. Their estimates however, are often revised at a higher level (Makridakis 1990). Consumer interviews which involve questioning current or prospective customers on projected purchases of the firm's products under different conditions relating to price, income, competition, products and advertising is also used. By aggregating the data collected on all relevant variables the firm can estimate its demand function. The information obtained however, is likely to be of doubtful quality since only hypothetical situation is used (Nicholson 1995; Landsburg 1991). Tsekeri (2009) has also estimated the short and long-term response of air passengers to change in relative air-sea travel cost components in competitive markets using a dynamic demand model. The model demonstrated the importance of considering the past volumes of air passengers and relative travel cost components to explain current air travel demand (see also Postotino 2003).

The multiple regression model is however the most reliable method for forecasting air travel demands (Uddin et al. 1986). The model relates variations in air traffic to variables of different socio-economic factors of the residents and seeks to derive an equation for demand in terms of price and other relevant variables. Multiple regression methods are designed to account also for variables in non-price factors.

MODELING DEMAND FOR AIR TRAVEL

Demand is the number of units of a particular product or service that customers are willing to purchase in a specified time period under specified conditions. The demand function is a statement of the relationship between the quantity demanded and the factors which affect this quantity. The function is usually expressed in the form:
$D = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + \ldots\ldots + a_nx_n$.
This is a multiple regression equation where D = quantity demanded, $x_1, x_2, x_3 \ldots x_n$ are independent variables influencing demand a_0 is the intercept while $a_1, a_2, a_3 \ldots a_n$ are parameters. This is a linear function which depicts very well demand relationships, and which can easily be solved using the method of least squares (Draper and Smith 1981; Johnston 1978).

Another commonly used model for demand relationships is the power function. This takes the form:
$D = a_0 x_1^{a_1} x_2^{a_2} x_3^{a_3} \ldots.. x_n^{a_n}$
This model assumes that the marginal effects of each variable on demand are not constant but depend on both the value of the variable and the values of all other variables in the demand function (Moutinho et al. 1998). The parameters of a power function may also be estimated by the method of least squares by first transforming the equation into a linear relationship by using logarithms (Zlatopher 1984).

Taking the logarithms of the power function, we obtain
$Log D = \log a_0 + a_1 \log x_1 + a_2 \log x_2 + a_3 \log x_3 \ldots.. a_n \log x_n$.
A multiplicative demand function such as this, also has constant elasticities over the complete range of values and these elasticities are given by the parameters $a_1, a_2, a_3 \ldots a_n$ which are estimated by regression analysis.

Empirical Validation of the Model

The demand for air transport can be explored by analysing time series data in relation to major economic indicators and other possible explanatory variables. In such analysis, the demand variable is the dependent variable while the independent variables include some macro-economic variables and sectoral ones relating to the aviation industry (FRN 1989).

The independent variables considered rel-

evant to this study are Index of Agricultural Pro-
duction, Index of Minerals Production; Index of
Manufacturing production; Index of Energy Con-
sumption; Consumer Price Index; Index of Elec-
tricity Consumption; Inflation Rate; Gross Do-
mestic Product; Federal Government Revenue.
The model for air transport demand therefore
takes the form:
DAT = f(IAP; IMP, IIP, IEC, CPI, ILC, IFR,
GDP, FGE).
where DAT = Demand for Air Transport; IAP =
Index of Agricultural Production; IMP = Index
of Minerals Production; IIP = Index of Manu-
facturing Production; IEC = Index of Energy
Consumption; CPI = Consumer Price Index; ILC
= Index of Electricity Consumption, IFR = In-
flation Rate; GDP = Gross Domestic Products;
FGE = Federal Government Expenditure in cur-
rent prices. These are all macro-economic vari-
ables which affect the aggregate demand for air
travel (see Osayimvese and Filani 1973; FGN
1989) and they are usually linked with economic
prosperity (Jimoh 2004). The variables also re-
flect the level of economic development of a
nation (Adeyemi 2001).

The data for the variables were obtained
through various sources. Data on Passenger-
kilometre (PKM); Aircraft-kilometre (AKM) and
Cargo-tonne-kilometre (CKM) were obtained
from the Federal Bureau of Statistics (FBS),
Annual Abstracts of Statistics; Central Bank of
Nigeria, Statistical Bulletin and Federal Minis-
try of Transport Statistics Digests. Data on Fed-
eral Government Expenditure (FGE), Index of
Manufacturing production (IIP), Gross Domes-
tic Product (GDP); Index of Energy Consump-
tion (IEC); Index of Agricultural production
(IAP); Consumer Price Index (CPI); Index of
Electricity Consumption (IEC); Index of Miner-
als Production (IMP) and Inflation Rate (IR)
were all obtained from the Central Bank of Ni-
geria Statistical Bulletin. Figures 4, 5, 6, 7 and 8
show the graphs of some of the independent vari-
ables.

Figure 4 shows that the Index of Agricultural

Production fluctuated between 1975 and 1983.
Thereafter there has been a gradual rise in agri-
cultural production since 1984 to 2006. This
could be due to greater attention being paid to
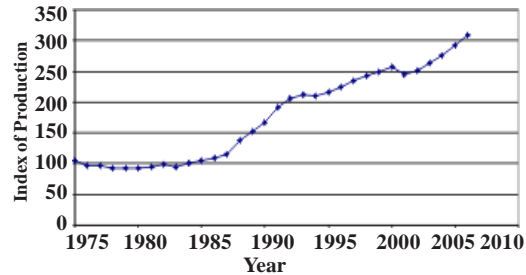agricultural development of government in the
country.

Fig. 4. Index of agricultural production
Source: The Author

In the case of Manufacturing Production, Fig-
ure 5 shows that the Index of Manufacturing Pro-
duction experienced fluctuations between 1975
and 2006. There was a gradual rise of the index
between 1975 and 1985 after which a small de-
cline was experienced in 1986. Thereafter, manu-
facturing production began to improve from 1987
to 1991 when it started to experience a decline
between 1992 and 1998. Thereafter, fluctuations
had set in again.
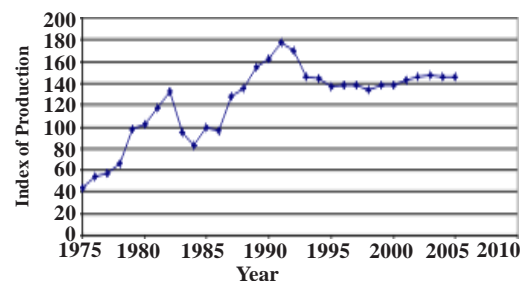
Fig. 5. Index of manufacturing production
Source: The Author

Principal Minerals Production was not steady
throughout the study period. The Index of Prin-
cipal Minerals Production as shown in Figure 6
shows that it experienced fluctuations, which
depended on the unsteady state of the economy.
However, the trend shows that principal miner-
als production appeared to have started picking
up since 2000 and it is hoped the trend will hence-
forth continue to improve more especially due
to government's reform policy of encouraging

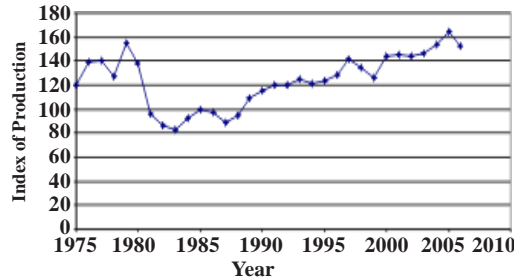private participation in many of the country's enterprises.

Fig. 6. Index of principal minerals production
Source: The Author

Gross Domestic Product in the country has been experiencing a gradual rise as shown in Figure 7. Although, a lot of effort has been made by the Federal Government to improve the Gross Domestic Product in the country, there have been various factors which appear to be stunting it. These include the level of employment and the deplorable state of infrastructural provision. However, with various reforms introduced by government to improve the state of the economy, Gross Domestic Product in the country shows signs of imminent improvement.
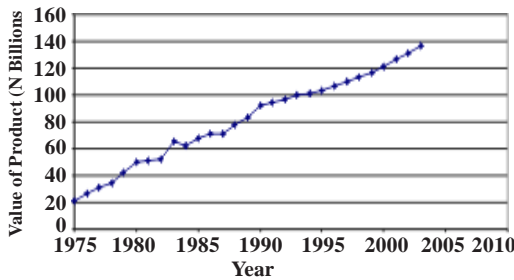

Fig. 7. Gross domestic product
Source: The Author

Federal Government Expenditure is a variable, which has experienced significant rise between 1975 and 2006. The index as shown in Figure 8 shows a gradual rise in federal government expenditure which is due to the need to provide basic social services for the people of this country. This trend is likely to continue due to government's resolve to ensure rapid development of the nation.

The demand model was operationalised in the form:

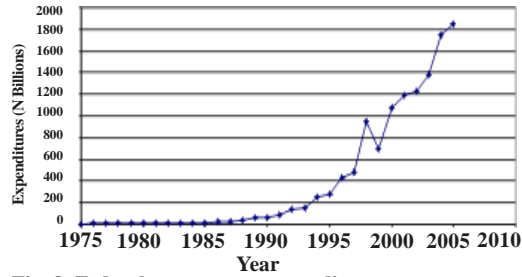$$DAT = a_0 IAP^{a_1} IMP^{a_2} IIP^{a_3} IEC^{a_4} CPI^{a_5} ILC^{a_6} IFR^{a_7} GDP^{a_8} FGE^{a_9}$$

Fig. 8. Federal government expenditures
Source: The Author

The assumption here is that the independent variables affect demand in a multiplicative manner. This assumption is not without justification since variables such as Federal Government Expenditure (FGE) and Gross Domestic Product (GDP) are apt to have interactive effects while Index of Manufacturing Production (IIP), Index of Agricultural Production (IAP); Index of Minerals Production (IMP) and Index of Electricity Consumption (ILC) are also expected to have interactive effects. Taking the logarithms of both sides of the model equation, we have:

$Log (DAT) = \log a_0 + a_1 \log IAP + a_2 \log IMP + a_3 \log IIP + a_4 \log IEC + a_5 \log CPI + a_6 \log ILC + a_7 \log IFR + a_8 \log GDP + a_9 \log FGE$

where a_0 = constant, $a_1 - a_9$ = parameters (coefficients) attached to the independent variables.

The regression procedure used for the analysis is the stepwise regression. The stepwise regression is a statistical method for selecting the most significant independent variables from any given set of variables (Draper and Smith 1981). The computation for the analysis was done using the SPSS (Statistical Package for the Social Sciences).

Table 1 shows the matrix of correlation between the independent variables. The results show that many of the variables are interrelated. For instance, Consumer Price Index (CPI) has a correlation coefficient of 0.968 with Index of Agricultural production (IAP). Similarly, Index of Electricity Consumption (ILC) has correlation coefficients of 0.831, 0.867 and 0.858 with Index of Agricultural Production (IAP), Index of Manufacturing Production (IMP) and Consumer Price Index (CPI) respectively. Also notable is

Table 1: Correlation matrix between the independent variables

	IAP	*IMP*	*IIP*	*IEC*	*CPI*	*IFR*	*ILC*	*GDP*	*FGE*
IAP	1.000								
IMP	0.699	1.000							
IIP	0.577	0.063	1.000						
IEC	0.407	0.661	-0.039	1.000					
CPI	0.968	0.685	0.537	0.419	1.000				
IFR	0.046	-0.043	-0.093	-0.144	0.035	1.000			
ILC	0.831	0.867	0.245	0.656	0.858	0.028	1.000		
GDP	0.859	0.887	0.142	0.633	0.922	-0.033	0.961	1.000	
FGE	0.969	0.668	0.596	0.487	0.969	-0.086	0.799	0.867	1.000

Source: Computer Output

Gross Domestic Product (GDP) with high correlation coefficients of 0.859; 0.887; 0.922 and 0.961 with Index of Agricultural production (IAP), Index of Manufacturing Production (IMP) and Index of Electricity Consumption (ILC) respectively. Federal Government Expenditure (FGE) also has high correlation coefficients of 0.969; 0.969 and 0.867 with Index of Agricultural Production (IAP); Consumer Price Index (CPI) and Gross Domestic Product (GDP) respectively.

This builds into the model the problem of multicollinearity (Hauser 1974). According to Leung (1982), the presence of pair -wise variables with a correlation value ± 0.82 creates the problem of collinearity in the data set. The stepwise technique has the inherent ability to overcome the problem of multicollinearity since it will select only those variables that make the greatest contribution to the dependent variable. The problem of multicollinearity is therefore mitigated in the model.

Passenger-kilometre and the Independent Variables

Table 2 is the regression summary for Passenger-kilometre and the independent variables. The stepwise regression selects only three of the nine independent variables. These three variables, namely Index of Agricultural Production (IAP), Index of Manufacturing Production (IMP) and Federal Government Expenditure (FGE) together account for 92.3% of the total variation in Domestic Passenger Movement. The remaining 7.7% are variables which cannot be included in the model because of their exogenous features. These are political factors which enable the political class to be able to afford the cost of air travel much more easily than other people in the country.

The regression summary also shows that only

Table 2: Regression summary for passenger-kilometre (PKM) and the independent variables

Dependent variable	Independent variables	Regression coefficient	Standard error	T-values	Levels of significance
Passenger-kilometre	Constant	3.750	1.023	3.664	0.001
	IAP	-1.958	0.641	-3.053	0.006*
	IMP	1.683	0.287	5.869	0.000*
	GDP	-0.297	0.132	-2.243	0.035*

$R^2 = 0.923$ DF = 3/22   F = 08.027 > 3.05
* Significant at 0.05 level

the index of manufacturing production has a positive effect on air travel. This may not be unconnected with the fact that this variable generally depends much on air transportation for the movement of industrial manufacturing input. The other two variables namely, Index of Agricultural Production and Gross Domestic Product have a decreasing effect on passenger-kilometre because they have their own important demand on the economy which are not necessarily positively influencing passenger movement. The insufficient attention given to agricultural production and the generally low Gross Domestic Product in the country are also contributory factors.

The model further shows that the three independent variables are significant at 0.05 level considering their t-value. The value of the coefficient of determination R^2 which is 92.3 percent shows that the model is a good fit for the data. The F-test also shows that the regression is significant since the F-statistic of 88.03 is higher than the critical value of 3.05 at 0.5 level of significance. The regression model obtained is:
Log (PKM) = 3.750 – 1.958 log (IAP) + 1.683 log (IMP) – 0.297 log (GDP).

Aircraft-kilometre and the Independent Variables

Table 3 is the regression summary for Aircraft-

kilometre and the independent variables. The stepwise regression method extracts only two of the nine independent variables namely Inflation Rate (IFR) and Gross Domestic Product (GDP) as being responsible for 83.4 per cent of the total variation in Aircraft-kilometre movement. The remaining 16.6 per cent of the total variation is unexplained by the combined influence of these two independent variables which cannot be included in the model due to exogenous factors.

The regression summary also shows that Gross Domestic Product (GDP) has an increasing effect on Aircraft-kilometre movement while Inflation Rate (IFR) has a negative effect. This could be due to the fact that increasing Gross Domestic Product would be beneficial and encouraging to aircraft movement and generally air travel because it reflects the wealth of the nation. However, increasing inflationary rate will discourage aircraft movement and air travel. In addition, both Inflationary Rate (IFR) and Gross Domestic Product (GDP) are significant at 0.05 level going by their t-values.

The model further shows that the two independent variables adequately explain the variation in the dependent variable with a coefficient of determination, R^2 of 83.4 percent implying that the model is a good fit for the data. The F-test also shows that the regression is significant since the F-statistic of 57.789 is higher than the critical value of 3.42 at 0.05 level of significance. The regression model obtained is:
Log (AKM) = 3.174 – 0.814 log (IFR) + 1.342 log (GDP)

Table 3: Regression summary of aircraft-kilometre (AKM) and the independent variables

Dependent variable	Independent variables	Regression coefficient	Standard error	T-values	Levels of significance
Aircraft kilometre	Constant	3.174	0.644	4.932	0.000
	IFR	-0.814	0.120	-6.807	0.000*
	GDP	1.342	0.482	2.786	0.000*

R^2 = 0.834   DF = 2/23   F = 57.789 > 3.42
* Significant at 0.05 level

Cargo-tonne-kilometre and the Independent Variables

Table 4 shows the regression summary for Cargo-tonne-kilometre and the independent variables. The stepwise regression method selects only two of the nine independent variables. These two independent variables namely, Index of Agricultural Production (IAP) and Consumer Price Index (CPI) account for only 37.6 percent of the total variation in domestic cargo movement. The remaining 62.4 percent are the total variance which cannot be explained by the combined influence of these two variables. These could be factors outside air travel such as stiff competition from the road mode, environmental and political influence.

Table 4: Regression summary of cargo-tonne-kilometre and independent variables

Dependent variable	Independent variables	Regression coefficient	Standard error	T-values
Cargo kilometer	Constant	-10.059	3.283	-3.064
	IAP	7.538	1.996	3.776*
	CPI	-1.525	0.442	-3.449*

R^2 = 0.376 DF = 2/22 F = 21.43 > 3.42

The regression summary shows that only the Index of Agricultural Production (IAP) has a positive influence on Cargo-tonne-kilometre while Consumer Price Index (CPI) has a negative influence. These may be due to the fact that the higher the level of Agricultural Production in the country, the higher the need for transportation of agricultural inputs which are usually faster by air. This however puts a toil on the consumers in terms of high cost of air transportation.

The model however gives just a fair explanation considering the low coefficient of determination of 37.6 percent and thus, the two independent variables cannot strongly predict the demand for cargo movement in the air transportation industry in the country. However, the model shows that the two independent variables are significant at 0.05 level considering the t-values. The F-test also shows that the regression is significant since the F-statistic of 21.429 is greater than the critical value of 3.42 at 0.05 level of significance. The regression model is: Log (CKM) = -10.059 + 7.538 log (IAP) – 1.525 log (CPI).

IMPLICATIONS FOR AIR TRANSPORTATION PLANNING IN NIGERIA

The demand for domestic air transport services has been examined in this study. The

behaviour of demand variables such as passenger movement, aircraft movement and cargo movement have been explored by analyzing the available time-series data in relation to major macro and micro economic explanatory variables. The results show that variables such as Index of Agricultural Production, Index of Manufacturing Production and Gross Domestic Product are important in the explanation of the demand for passenger movement. Similarly two independent variables, namely Inflationary Rate and Gross Domestic Product, are important in the explanation of the demand for Aircraft Movement. Also, only two independent variables, namely Index of Agricultural Production and Consumer Price Index are important in the explanation of the demand for cargo movement.

The results portray the need for a more stable economic atmosphere to promote air travel in Nigeria. Since the attainment of Nigeria's political independence, the major problem has not been the inability to draw up well articulated strategies, programmes and policies as contained in the series of development and rolling plans but rather the inability to successfully implement the plan policies and programmes (Adeyemi 2001). The country has witnessed, over the past two decades, a rapid decline in per capita income, massive unemployment and declining productivity. These are as a result of the poor state of the economy. Also, inadequate capital has remained a major hardship to individual, corporate and government interest in the aviation industry (Ogunbodede 2006). Thus, inadequate fund and experienced manpower have made it impossible for the industry to flourish the way it is operated in advanced countries.

Limited success has also been achieved in government's effort to promote industrialization which could have impact on economic growth and development. Spatially separated centers of industrial and commercial developments need to be effectively linked for rapid development and air transport alone performs this function best.

Other issues as increase in Gross Domestic Product, Foreign Exchange Earnings and export of more diversified products will have positive effect on the economy and consequently demand for air transport.

There is also the need to make safety the watchword in the aviation industry in Nigeria. A study of aircraft disasters in Nigeria between 1969 and 2006 shows that over 1,267 passengers have been killed (Aderamo 2006b). This is a loss too much for the country to bear.

CONCLUSION

Amongst all different modes of transport, air transport is still reported to be the fastest and is also capable of providing both place utility and time utility functions the best (Ogunsaya 2005). However, the demand for air transport in Nigeria for both passengers and goods transportation is not high enough. This could be due to problems such as the state of the route planning, safety and general administration. Besides, subsidy by government for the improvement of air transportation system in the country is still poor.

This study has identified some of the factors that determine the demand pattern for air transport services in the country. The paper also suggests ways of improving the services.

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