


TRANSPORT FINDINGS

Are Telecommunications and Travel Substitutes or Complements? An Empirical Analysis of a Developing City in Nigeria

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Keywords: telecommunication, travel behaviour, mobility, complementarity, substitution

<https://doi.org/10.32866/001c.30742>

Findings

This study examines the relationship between household travel and telecommunication use with data collected from 498 participants in Akure metropolis, Nigeria and finds that a positive relationship exists between telecommunication and travel. While the substitution effect of telecommunication on the trip was not significant in the study, the result of the multinomial logistic regression revealed telecommunications complements travel more than substitute.

1. QUESTIONS

The possible relationships between information and communications technology (ICT) (or telecommunication) and physical travel include substitution, complementarity or modification, generation, and neutrality (Mokhtarian 1990; Mokhtarian and Salomon 2002; Nobis and Lenz 2003). Complementarity occurs where there is a modification or change of spatial and temporal characteristics of existing travel patterns by the use of telecommunications, while substitution refers to the number of trips being replaced by ICT (Senbil and Kitamura 2004; Oyesiku 1996). Unlike previous studies (Matous 2017; Olawole 2013) that focused on mobile phones, this study examines the relationship between household travel and telecommunication, which extends beyond call linkages to virtual activities such as e-shopping, e-banking, telework, to mention just a few. The research questions include:

- What are the nature and characteristics of telecommunication in the study area?
- Do telecommunications substitute for physical travel?
- Is there clear evidence of the relationship between telecommunication and travel in the study?

Research Hypothesis

H₀- There is no significant relationship between telecommunication usage and travel.

H₁- There is a significant relationship between telecommunication usage and travel.

2. METHODS

This study uses primary data collected from a survey, which was conducted using trained research assistants and a questionnaire. A probability sampling technique was adopted, and a multi-stage sampling procedure was used. The first stage involved the stratification of residential areas and the selection of political wards. Of 11 political wards, 6 were sampled. Random sampling was adopted in selecting 38 registered streets from a total of 139, representing 20% of the streets in the selected wards.

Further information from the Area Town Planning Area office revealed that there are 5,123 registered buildings in the selected wards, of which 10% were systematically selected. Bookwalter, Fuller, and Dalenberg (2006) and Owoeye, Fadare, and Ojekunle (2018) justified surveying only the household head within the family on the basis that the response of household heads is mainly determined by factors shared by the entire household and not on those experienced primarily by the head. Where the respondent was not available, the next building was selected for the sample. A household head not below the age of 18 years (adult) on the first floor of each selected building was sampled. Based on this, a total of 512 respondents were surveyed. However, a total of 498 questionnaires (97%) were found usable for analysis.

The questionnaire designed for the research had three main sections. Section 1 comprised information relating to the socio-economic characteristics of the respondents. They included gender, age, education, income, marital status, employment status, occupation, and car ownership. Section 2 focuses on the travel characteristics of the people, information such as trip frequency (Average number of round trips), trip purpose (work, shopping, health, recreation), transport mode and travel cost were acquired. The last section comprised information on the telecommunication usage of respondents, questions relating to the type and number of telecommunication own (GSM or PC), the average number of trips complemented/substituted by telecommunication, trip activities/complemented or substituted by telecommunication among others.

Information on the socio-economic characteristics of respondents revealed that the majority were male (54.1%), married (72.8%), had tertiary education (72.1%), 54.8% earned between ₦40,000 - ₦60,000. Hence the majority earned above the federal government minimum income wage of ₦20,000. Analysis of trip frequency showed that 50.8% made an average of 4 trips daily trips. Work trips comprised the majority (82.8%) of trips. A smaller majority (50.7%) made use of public transport. The telecommunication usage of households revealed that 98.2% owned a mobile phone while (55.2%) did not make use of virtual activities/platforms such as e-banking, email, and e-shopping. Facebook and WhatsApp were the most used smartphone applications, with 40.3% and 28.2% of the respondents, respectively.

Table 1. Socio-economic characteristics of Households

Characteristics	Variables	Frequency	Per cent
Gender	Male	276	54.1
	Female	234	45.9
Age	Less than 30 years	127	33.6
	30-39	114	30.1
	40-49	80	21.2
	50-59	38	10.1
	60-69	13	3.4
	70 years and above	6	1.6
Marital status	Single	125	24.7
	Married	369	72.8
	Divorced	8	1.6
	Widowed	5	0.9
Household size	Less than 6 persons	217	51.5
	6 - 9 persons	188	44.6
	10 persons and above	15	3.9
Educational status	No formal education	6	1.2
	Primary school education	37	7.4
	Secondary school education	90	18.0
	Tertiary education	361	72.1
	Other	7	1.4
Occupation of respondents	Civil servant	174	40.4
	Artisan/self-employed	51	11
	Businessmen/women	129	8
	NGO/Private organization	21	29.9
	Health worker	13	3.0
	Farming	2	.5
	Others	41	9.5
Average monthly income	<20,000	47	9.4
	20,000 - 39,999	42	8.4
	40,000 - 59,999	274	54.8
	60,000 - 79,999	23	4.6
	80,000 - 99,999	20	4.0
	100,000 and above	94	18.8
Number of cars in the household	None	30	9.8
	1	151	49.2
	2	100	32.5
	3	12	3.9
	4	13	4.2
	5	1	0.3
Number of years spent in the pursuit of tertiary education	0 - 2 years	80	21.4
	3 - 5 years	233	62.5
	6 - 9 years	55	14.7
	10 years and above	5	1.3
Travel Characteristics	Variable	Frequency	Percent
Number of trips (per day)	1	94	20.1
	2	75	16
	3	41	8.8

	4	237	50.8
	5	6	1.3
	6 and above	14	3.0s
Purpose of the trip	Work	395	82.8
	Shopping	4	.8
	School	43	9.0
	Recreation	1	.2
	Farm	13	2.7
	Place of worship	20	4.2
	Others	1	.2
Dominant mode of transportation used	Walking	38	8.6
	Bicycle	11	2.5
	Private car	162	36.8
	Public transport	223	50.7
	Others	6	1.4
Telecommunications usage of Respondents			
Access to telecommunication facility	Yes	498	100
	No	-	-
Type of telecommunication facility frequently used	Mobile Phone (GSM)	299	58.6
Personal computer/tablet	111	21.8	
	None	100	19.6
Social media as a means of communication	WhatsApp	144	30
	Instagram	10	2.0
	Twitter	12	2.4
	Facebook	206	41.3
	None	126	25

Source: Author's Field Work, 2020.

The socio-economic characteristics of respondents revealed that the majority were educated and employed with the government as civil servants. The number of government-employed respondents is not surprising because an individual's highest level of education determines the kind of occupation such a person can engage in and the income level (Ahn 2001; Badiora 2012; Stead and Marshall 2001).

The result of the average number of self-reported complemented and substituted trips by different ICT means is explained in [Table 2](#). It is evident from the study that the use of a mobile phone (Global System of Mobile Communication (GSM)) for making calls was more predominant in the study area as a larger volume of trips were influenced through that platform, unlike emails, e-shopping, e-banking and social media platforms.

3. FINDINGS

The result on trip frequency corroborates the findings of (Hine, Barnejee, and Kashyap 2012), which asserted that urban form influences one's travel behaviour, as such, urban dwellers generate more trips than those in remote locations due to factors ranging from their socio-economic characteristics, access to public transport or private cars among others. As such, the large

Table 2. Average number of complemented and substituted trips by ICT means

Telecommunication Means	Number of Complemented Trips	Number of Substituted Trips	
Mobile phone (GSM calls)	932 (51.7%)	869 (48.2%)	
Email	664 (64.2%)	369 (35.8%)	
E-banking	462 (60.8%)	298 (39.2%)	
E-shopping	402 (41.5)	568 (58.5%)	
Social Media Platforms	525 (51.2%)	495 (48.3%)	
Total	2985 (53.4%)	2599 (46.5%)	5584

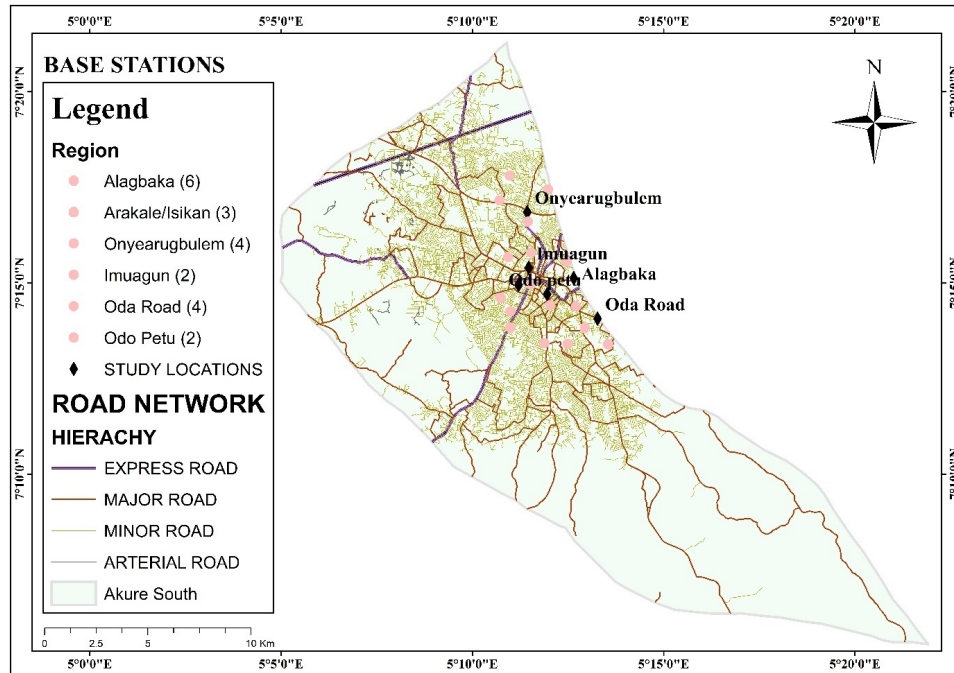


Figure 1. Study Area and Telecommunication Point Map for the Study areas.

Source: Arc Map/Fieldwork 2020

number of trips generated by respondents may be a function of some of these highlighted factors since most of them had access to either a private car or public transport.

Concerning telecommunication usage, the use of virtual platforms such as e-banking, e-shopping, telework, and e-business to replace physical movement were not significant as respondents rely more on telecommunications for a reorganization of activities or modifications with respect to time and space. It, thus, stipulates that a larger percentage of the population still embarks on physical trips against virtual activities. Overall, 53.4% of trips were complemented by telecommunication. A close reflection showed that 58.5% of total shopping trips were replaced by telecommunication, thus, in contrast with the findings of Farag et al. (2007) and Douma et al. (2004), which concluded that e-shopping is used as an additional shopping method which does not change trip making behaviour nor replaces in-store shopping but does change shopping behaviour.

The hypothesis testing result revealed that a positive relationship exists between the average number of trips complemented and telecommunication usage (call volume). This implies that the null (H^0) hypothesis is rejected, and the alternative (H^1) hypothesis is accepted. The correlation coefficient for the relationship between telecommunication usage and complemented trips in the study is 0.535, significant at 0.00.

Multinomial logistic regression (logit) analysis was further carried out using SPSS to determine the impact of telecommunication on travel of households. The dependent variables, in this case, represents self-reported capacity for telecommunication to either substitute [0] or complement [1] overall travel. The independent variables represent the gender (male [1], female[0]), Age, and household size of respondents which was categorized into small [1,0], medium [1,0], and large [1,0].

The model fitting information contains a likelihood ratio chi-square test comparing the full model (predictors) against a null or intercept only model. The statistical significance (0.032) indicates that the full model represents a significant improvement in fit over the null model. [X^2 (9) 18.315, $P=0.032$]. The Pearson and deviance chi-square test indicates that the model is a good fit, [X^2 (293) =267.047, $P= 0.859$], [X^2 (293)=218.370, $P= 1.000$] respectively. The result of the likelihood ratio test which explains the overall contribution of each independent variable revealed that household size and gender with $P = 0.00$ and $P = 0.04$ respectively were significant variables influencing the complementarity ability of telecommunication on travel. From the model equation, even though the complementarity effect of telecommunication on travel was significant in this study, male household heads were more likely to complement their trips ($P = 0.035$) than females. For the parameter table, the coefficient represents comparison between telecommunication capacity to complement (1) and telecommunication capacity to substitute (0). In this case, gender (male) and household size were significant. This implies that telecommunication was more likely to complement trips rather than substitute.

Although the study found a substitution effect of ICT on shopping trips, it, however, supports the perspective that the overall trend of the relationship is shifting from substitution to complementarity, which has been widely discussed in previous studies (De Graaff and Rietveld 2007; Wajuade 2014). Findings from the study corroborate the studies of Oyesiku (1996) and Choi, Choo, and Kim (2020) that telecommunication cannot fully compensate for face-to-face contact, for instance, the conveyance of complex, non-structured, or potentially ambiguous information. Also, the social and cultural background of people in Nigeria, a developing country, is such that the physical presence of friends and relatives is often appreciated; hence telecommunication may not be able to fully substitute travel. Overall, the impact of

Table 3. Logit Model: Dependent Variable Capacity for Telecommunication to Complement (1) or Substitute (0)

	B	Std. Error	Wald	Sig.	Exp(B)
Intercept	5.213	.288	6.087	.001	
Age	.008	.010	.671	.413	.992
HH Size = Small [1,0]	3.830	.586	6.342	.000	4.693
HH Size = Medium [1,0]	2.380	.319	4.380	.000	3.459
Male [1,0]	.574	.344	2.790	.035	1.776

Notes: Pseudo-R²: Cox and Snell: 0.251, Nagelkerke: 0.323, McFadden: 0.150.

telecommunication on travel depends largely on individuals' socio-economic attributes such as gender and household size, and activity patterns (shopping, work, banking, etc.) of an individual or household.

Acknowledgement

The author wishes to acknowledge the support of Management and staff of Akure South Local Government Authorities, National Population Commission, Ondo state, Ministry of Physical Planning and Urban Development, Federal University of Technology Akure, Ondo state Nigeria and University of Johannesburg South Africa, for providing relevant information and support for the successful completion of the work.

Submitted: August 06, 2021 AEDT, Accepted: December 13, 2021 AEDT



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SUPPLEMENTARY MATERIALS

Supplementary Information: Survey Instrument

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