Determinants of Internet Adoption and Use in Eritrea: Evidences From the City of Asmara

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ABSTRACT

The objective of this paper is to determine what factors stimulate or hinder the adoption and usage of the Internet by analyzing data collected from 300 respondents from the city of Asmara, Eritrea in the year 2017. We adopted a micro-econometric approach (Multinomial logit model -MNL) and the paper identifies six significant determinants and estimated their impact with the help of econometric tests. The results show that internet users in the city of Asmara tend to be young and in better living conditions. The probability of using the Internet is also higher for people with better English ability and for individuals' who have better computer savvy. Moreover, Internet users are more likely to have close family members and friends who also use the internet. These results provide evidence of not only digital divide in the Internet access, but also in the usage patterns in the city.

Key Words:
Internet adoption, usage, developing country, Eritrea.

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INTRODUCTION

The worldwide computer network dubbed as Internet has become the everyday word for different ages, sex, career, academic status etc. bringing the world together just like a global village. Though, the technology and its use emanated from the United States, nowadays populaces from every corner of the globe are enjoying its services (Anunobi, 2009).

The Internet has been/is spreading rapidly throughout the world. This can be seen from the increase in the number of hosts (computers connected to the Internet) and Internet users in the world. According to Internet Systems Consortium, the number of hosts increased from 93,047,785 in July 2000 to 353,284,187 in July 2005, while the report by the International Telecommunication Union (ITU) indicated that the number of Internet users increased from 490 million in 2001 to 841 million in the end of 2004 (ITU Telecommunication Indicators, 2004).

However, the expansion of Internet is not fairly distributed throughout the world. For instance 50% of the worldwide bandwidth capacity is in North America. This situation presents a sharp contrast with observations from Africa. As of the end of 2010, the Internet use rate throughout Africa stood at 9.6% and in 2013, the rate is estimated to be at 16% compared with above 75% in Europe (Penard, 2012).

Moreover, the gap in Internet use rates between developed countries and the African continent has tended to widen in recent years. This "digital divide" has become exacerbated as regards the quality of Internet access. Most users in developed nations have a broadband connection at home whereas online speeds experienced in Africa are still very slow and impede access to certain uses requiring large bandwidth.

Beilock and Dimitrova (2003), found that per capita income, average level of education (i.e. human capital), degree of competition among Internet Service Providers, the country's Anglophone heritage and the density and quality of telecommunication infrastructure as the main reasons for discrepancies in penetration rates between developed and developing countries.

People's reasons for using the Internet vary, though many people use the Internet for more than one purpose. Some authors discovered that 60% of college students use Internet for school related activities. Other uses of Internet by the students are e-mail (55%) entertainment (50%) and chatting (24%) (Savolainen and Kari, 2004; Palesh et al. 2004). Along the same line, Nigerian students' use of Internet was revealed to include knowledge improvement, search for materials needed for assignment and for research (Anunobi, 2009).

There have also been studies on the number of visit to the Internet and the length of time spent surfing. In some cases people's priority determines their use of time. In effect, younger Internet users have more time at their disposal than those in their 30s and 40s who could not use much of the time for social activities online. Those aged 50 and older have more free time than the middle age and therefore can also use it for online social activities (Miller, 1996).

Studying the rate of Internet use by students in Nigerian Universities, it was found that more people 38.24% and 22.06% use it on weekly and daily basis respectively than 11.76% who used it on monthly and bi-monthly basis (Jagboro, 2003). However, the rate of use of Internet has increased rapidly since mid-1990s (Savolainen and Kari, 2004). Contrary to findings of Jagboro (2003), Amaeshi et al. (2006) found that most people (41.25%) use the Internet when the need arises.

Furthermore, Fekadu (2006), using data from Addis Ababa, Ethiopia, found out that the likelihood of access to the Internet by a firm is explained by the level of the education of the management, level of sales of the business and its openness to international trade. Furthermore, results showed that among the connected businesses the use of Internet is

limited to email and browsing, while advanced electronics uses such as E-commerce, E-procurement, etc. are almost on-existent.

There have always been concerns on the users of the Internet globally. This is unconnected with its implication to the global development. These concerns were often focused on who, how, why and when of the Internet use. Part of the response to the latter is the identification of the determinants of Internet use. Though such characteristics have been identified and available for many international communities not much has been done in some local communities in places like Eritrea irrespective of some Internet resources are available to the communities. Consequently, Internet stakeholders in the community may not appreciate the implication of such service vis-à-vis the economic, social, political and education development of the users.

It is imperative to fill this gap by identifying the characteristics of Internet users in the city of Asmara, Eritrea where the majority of the nation's internet facilities are located. To this end, the main objective of this paper is to understand the choice of adoption and use of internet in the city. Thus, in this endeavor we try to investigate what factors stimulate or hinder the adoption and usage of the Internet in the country. Similarly we attempt to observe whether these factors are similar to those observed in studies conducted in other countries or not. To address these issues, we adopt a micro-econometric approach and use household survey data from metropolitan Asmara. The survey was conducted on a representative sample of 300 residents of the country's capital city, in 2017. The city offers several interesting features to study Internet use and digital divide issues.

Early studies on the adoption and use of Internet by households and individuals in developed countries ascertained the primary role of socioeconomic factors. In the early days Madden *et al.,* (2004), examined a database of 5,000 survey responses collected in Australian homes and discovered that demographic characteristics are one of the main influences on the individual decision to use the broadband Internet service. For example, they demonstrated, among other things, that people who have not finished secondary school show less of an interest in using the broadband Internet service. Moreover, they discovered that people who live in homes with at least one native member from Europe or Asia are more interested in the use of Internet and age also influences interest depending on whether the individual is younger or older than 65 years of age.

Afore indicated literature from the developed world showed that different factors determine Internet use. However, there have been few studies that discuss Internet use and its determinants in developing countries in general and African countries in particular.

To the best of our knowledge, no empirical studies have been conducted to closely identify and compare the determinants of Internet adoption and usage patterns at the individual level in Eritrea. The objective and contribution of this paper is to clearly provide insights on the factors that explain Internet use and the disparities in online usage among Internet users in the country.

The determinants of Internet users when elucidated will aid the country and the local community in influencing the present and future effect of such service on the different members of the society. Stakeholders on the Internet will fully appreciate the gains and pains of this technology vis-à-vis the global, economic, socio-political and educational development of the community. Thus, the aim of this paper is to present practical and proper data to policy decision-makers in the information and communications technology sector in an effort to enhance their vision on developing Internet adoption.

1. RESEARCH METHODOLOGY

The study methodology in this paper is based on the primary and secondary data collected from the city of Asmara, Eritrea in 2017. Secondary data was collected from EriTel – the sole telephone and Internet service provider in the country and primary data was collected from individual residents of the city using survey questionnaire. The survey was conducted between the months of March and May, 2017. A total number of 350 questionnaires were distributed and data from 300 correctly completed questionnaires were used. Individuals were contacted based on a stratified random sample of residential addresses and were requested to give information related to the adoption and use of the Internet.

To analyze the determinants of Internet usage patterns, we estimate a Multinomial logit (MNL) model with whether the respondent uses the Internet regularly, occasionally or not at all as the dependent variables. This study provides a practical explanation of the different determinants of Internet usability in the city. Thus, the study employs a quantitative approach for the purpose of examining magnitudes of the effects of various factors. Data collected were analyzed and interpreted by using SPSS version 23 and multinomial logit (MNL) regression model.

Our final sample contains 300 individuals which are representative to the population of the city. The explanatory variables used in the Internet usage model can be grouped into three categories—the individual's socioeconomic characteristics, IT (information technology) skills and command of English language, social capital and social neighborhoods. Data on the respondent's socio-demographic characteristics includes variable such as such as gender, age, living conditions, education, household size, marital status, occupational status and income. In addition, information on the respondent's degree of command of the English language and degree of computer skills was also collected. Data on social capital was acquired

by asking respondents whether they belong as member in any neighborhood associations such as ROSCAS, sport clubs… etc. In addition we also collected information by asking respondents whether they have close relatives and friends who also use the Internet.

2. DATA ANALYSIS

The logit model is the most common economic method of describing how individuals choose between different alternatives and it is based on the assumption that individuals choose the alternative that provides them the highest utility. The model also shows how strongly different factors influence the choice of alternatives and the linkages between the factors/variables (Algers and Widlert, 1995).

The explanatory variables used in the Internet usage model can be grouped into three categories—the individual's socioeconomic characteristics, IT (information technology) skills and command of English language, and social capital and social neighborhoods. The utility of the alternative choices is dependent on these alternatives. The utility is described as a function of these factors (variables).The respondents under study are faced with three Internet usage choices; no use, occasional - and regular use. It is assumed that these decisions are made on the basis of the option which maximizes their utility, subject to institutional and technical constraints.

The parameters of the individual latent utility function are estimated based on information from the responses to the questions posed. In this paper, we use this framework to analyze the characteristics of Internet usage in the case of Asmara city residents and to look for relationships that the above characteristics such as sex, age, education, income and others have with the individuals that use the Internet.

The individual decision of whether to use the Internet was considered under the general framework of utility. In this context, the utility of the economic agents is not observable, but the

actions of the economic agents could be observed through the choices they made.

These models were first introduced in the context of binary choice models, where the logistic distribution is used to derive the probability. Their generalization to more than two alternatives is referred to as Multinomial logit (MNL) model (McFadden (1974).

McFadden (1974) model is preferred since it permits the analysis of decision across more than two categories in the dependent variable therefore making it possible to determine choice probabilities of different choices. In addition, MNL is simpler to compute compared to Multinomial Probit (MNP) model which poses a challenge in computing multivariate normal probabilities for any dimensionality above two (Greene, 2000).

The modeler assumes the utility U_{ij} of Internet usage choices i (no use, occasional, and regular use) by and individual j, and includes a deterministic component V_{ij} and an additive random component ε_{ij}

$$U_{ij} = V_{ij} + \varepsilon_{ij} \qquad (1)$$

Here, the deterministic component of the utility function is linear in parameters. Assuming that the random component, which represents errors in the modeler's ability to represent all the elements that influence the utility of internet use or no use to an individual, is independently and identically Gumbel-distributed across individuals, the MNL model is as follows:

$$P_{ij} = \frac{exp\ Vij}{\sum_{i'}^{I} exp\ Vij} \qquad (2)$$

Where P_{ij} is the probability that choice i's chosen by individual j and i is the set of different internet use choices. The closed form of the MNL makes it straightforward to estimate (maximum likelihood estimation procedure), interpret and use. Detailed work on theory,

shortcomings and some applications can be found in the literature (Greene, 2003).

SPSS analytical system has been used to determine which parts of the questionnaire were relevant and which were not to each other. The procedure used for the variables assesses the number of commonly used measures and also provides information on the relationships between the individual use choice and the independent variables such as socio-demographic, social capital and computer and English language skills.

The designing of choice model needs extensive evaluation of observed data and the efficiency of the whole model system. In the current study, specific parameters are predicted to impact individuals' behavior, when individuals have different choices. Some of the parameters (such as, education and income) are considered to be substantial in literature, while other variables are presented exclusively to deal with specific research problems. These requirements consist of the parameters such as gender (*Gender*), educational (*Education*) level, monthly income(*Income*) in Eritrean Nakfa, age(*Age*), occupation(*Occupation*), living conditions (*L.conditions*), household size(*HHSize*) and marital status (*Mstatus*) of the respondent. In addition, social capital variables such as whether the respondent is a member of any local association (Association) such sport clubs and credit unions etc. are also added. Moreover, data is collected by inquiring the respondent whether any family member (*Family*) and friends (*Friends*) make use of the internet. Moreover, computer skills (*C.Skills*) and command of the English language (*E. Command*) of the respondents is also included.

A MNL model for all choices has been designed for three options such as, *no use, occasional and regular use* to compare and determine the aspects, which might impact people to start to exploit the benefits of the World Wide Web (W.W.W). In this model, the dependent variable was "0" for no use, "1" for regular use and "2" for occasional use.

The results can be used to find, understand and compare the attractiveness of each choice and determine the reasons and motives behind each of these choices.

DISCUSSIONS OF RESULTS

Descriptive Analysis

The data comprises of 300 respondents from the city of Asmara of which 40% of these are females. Out of the total respondents, 68 are no user, 150 of the respondents use Internet on regular basis and 82 of respondents use the Internet on occasional basis.

Table 1: Summary Statistics

Adoption choices	Frequency	Percent
No use	68	22.7%
Regular use	150	50%
Occasional use	82	27.3%
TOTAL	300	100
Socio-economic status		
Gender	Frequency	Percent
Male	180	60.0%
Female	120	40.0%
TOTAL	300	100

Determinants of Internet Adoption

In doing the analysis, the 'no use' was used as a base (reference) so that the other two choices (regular and occasional use) were compared to this base. The model summary as presented in table 2 below shows a Likelihood Ratio value of 190.938 which is significant at the 0.0001 level. The Pseudo R-squared values (Cox, Snell and Nagelkerke) of 0.471 and 0.538 reveal the model is useful in predicting the internet adoption choice of respondents. Table 2 and table 3 provide further details.

Table 2: Model Summary

Model	Fitting criteria	Likelihood Ratio Tests		
Intercept only	591.108	Chi-square	Df	Significance
Final	400.170	190.938	50	0.0001
The Goodness-of -Fit				
Pearson		515.309	476	0.103
Deviance		375.629	476	1.000
Pseudo R-squared		Cox and Snell	Nagelkerke	McFadden
		0.471	0.538	0.307

Table 3 Classification

Observed	Predicted			
	No use	Regular use	Occasional use	Percent Correct
No use	44	22	2	64.7%
Regular use	9	117	24	78.0%
Occasional use	1	42	39	47.6%
Overall Percentage	18.0%	60.3%	21.7%	66.7%

The regression results as presented in table 4 below shows that age (*Age*), living conditions (*L. condition*), command of English language (*E. Commands*), computer skills (*C. Skills*) family members (*Family*) and close friends (*Friends*) using the internet statistically affect the probability that a respondent never uses an internet or uses an internet on regular or occasional basis.

Table 4: MNL results for regular use and occasional use choices compared to no use choice

Variables	Regular Use				Occasional Use			
	Coeffi.	Std. error	Sig.	Odds Ratio	Coeffi.	Std. error	Sig.	Odds Ratio
Intercept	-26.356	2.295	0.000		-10.410	3.147	0.001	
Gender	0.575	0.456	0.207	1.778	0.091	0.528	0.864	1.095
Age (below 20)	3.023	1.271	0.017*	20.551	3.623	1.577	0.022*	37.446
Age (21-40)	3.686	1.118	0.001*	39.882	4.164	1.367	0.002*	64.334
Age (41-50)	2.012	0.957	0.035*	7.481	2.412	1.183	0.042*	11.153
Education	0.314	0.856	0.713	1.369	0.207	0.984	0.833	1.231
L. condition (v. difficult)	1.547	0.949	0.103	4.695	0.570	1.239	0.645	1.769
L. condition (difficult)	-0.992	0.438	0.024*	0.371	-1.193	0.528	0.024*	0.303
M. status	0.293	0.561	0.601	1.341	0.344	0.700	0.623	1.411
Income	-0.471	0.630	0.454	0.624	-0.574	0.819	0.483	0.563
E. commands (v.good)	1.030	0.688	0.134	2.801	3.205	1.052	0.002*	24.646
E.command (good + faire)	0.362	0.533	0.497	1.437	2.285	0.946	0.016*	9.822
C. skills (V.good)	1.820	.879	0.039*	6.170	3.359	1.408	0.017*	28.747
C.skills (good)	2.025	.630	0.001*	7.578	2.675	1.258	0.033*	14.515
Association	-0.316	0.446	0.478	0.729	-.395	0.519	0.447	0.674
Family (yes)	1.331	0.667	0.046*	3.785	2.823	1.192	0.018*	16.834
Friends (yes)	1.765	0.626	0.005*	5.841	2.576	1.019	0.011*	13.143

a. The reference category is No use

b. * Statistically significant at 5% significance probability level

Based on literature, several variables were used in the tuning process. Some of the models that were analyzed have revealed inadequate statistical goodness of- fit and/or had counter-intuitive signs; and therefore, some were invalidated and discarded. Table 4 above presents the most acceptable model. Many variables were tested during the tuning process, but due to space considerations these trials are not presented here. As stated previously, the basic idea behind the mode choice estimation was to identify factors

influencing respondents' choice to use or no use internet. The basic test of the estimates are indicated by their signs (+ or -).The summary of estimations using the MNL model is presented in the above table. Almost all of the variables presented have significant parameter estimates and logical signs.

Age

In this research, the demographic variable age (*Age*) has substantially contributed to explain the regular and occasional use choices behavior. Age is distributed into four categories and the coefficients for age were positive from the age category twenty and below (20 and below) up to the age of fifty (41 to 50). This implied that as age of the respondent increases from early childhood until the age of 50he/she is more likely to use the internet. The odds ratio is also above one supporting the argument. This result is due to the fact that so young children may have less access to internet but as their age increases the probability of choosing to use the internet increases, but as the age of respondents reaches 50 the choice to use the internet starts to fall down.

Living Conditions

This variable (living situation) is introduced to explain regular and occasional use choices behavior of the respondent by giving a choice to respondents from very difficult, difficult or easy (comfortable). The result was found to be negative and significant for the category (difficult) for both choices (regular and occasional use), indicating that the probability of use decrease as we move from easy (comfortable) living condition to difficult conditions. The result simply shows that the use of the internet is highly associated with the living standard of the respondents.

Command of English Language

Literature indicates that many resources in the internet are given in English language encouraging people who have command of the language to make more use of the internet in contrast with people of less command. The coefficient of command of English language (*E. command*) has three categories namely very good, good and poor and is found to be positive and significant for the category very good and good indicating that with increase in command of the English language the probability of the occasional use the internet increases.

Computer Skills

This variable is introduced to measure computer skills of respondents by giving respondents options to choose ranging from very good, good to poor. The result for the category very good and good were found to be positive and significant; indicating that the probability of regular and occasional use increases as we move from very good and good computer skills. Thus, people require at least elementary knowledge of computer skills to make use of internet resources.

Family members using the internet

This variable is introduced to explain whether close family members of the respondent use the internet by asking respondents a Yes /No alternative. The result was found to be positive and significant for both choices (regular and occasional use), indicating that the probability of use increase as family members of the respondent also use the internet at regular and occasional basis.

Close friends using the internet

Similarly respondents were asked whether their close friends use the internet on regular or occasional basis. The coefficients for this variable were positive for both choices, indicating that the probability of internet use increases as the respondents' close friends also use the internet on regular and occasional basis.

CONCLUSIONS AND IMPLICATIONS

The objective of this study is to compare the determinants of Internet adoption and usage by the residents of the city of Asmara. The data was collected in 2017 through stratified random

sampling where the questionnaires were collected with face to face interviews, which increases the reliability of the sample.

The literature has revealed the existence of two levels of digital divide: a first-level divide between those who have already adopted the use of the Internet and those who (still) have not (i.e. an accessibility divide); and a second-level divide within the adopters, between those able to master use of these technologies and those with a skills deficit in operating these technologies (i.e. a usage divide) (Hargittai 2002). The first-level divide remains considerable on the African continent, especially in matter of Internet access. Yet the second-level divide gives rise to an equally important challenge, as a large portion of the population is illiterate with no exposure to Information Technology **(**Drouard, 2010**).**

In line with accessibility divide we tried to collect data on whether the respondent use or not use the Internet and for those who use the internet we asked the frequency of use (regular or occasional use). Again in line with the second divide (usage divide) we collected data on the respondent's degree of command of the English language and his/her ability (knowhow) of working with the computer. In addition we collected also data of the respondents' socio-demographic and social capital (social neighborhoods) variables.

Multinomial logit model was used to determine the factors that influence the usage of the Internet. Consistent with the literature our paper has demonstrated that the decision to use the Internet is influenced by different sets of factors. These determinants which significantly influence the decision were age (in this case, younger than 50 years), living conditions, command of English language, computing skills and social capital (as measured by whether

close friends and family members use the internet). Findings of the paper strongly concur with the results of earlier studies in other countries.

This study is the first of its kind in Eritrea and it attempts to critically evaluate the trend of use/non-use of the Internet in Asmara and provides immense scope for future studies on the impact of behavioral changes and changes in the life style of Eritrean people on use/no-use of the Internet. Accordingly, further and broader research is needed, with regard to the usage of this technology and other ICTs, like mobile phones. This study also proves to be vital in development of future government policy for encouraging Internet use and investment in infrastructure. Hence, it aids in some useful regulations related to education and information technology development in Eritrea.

Despite the important benefits of information technology, digital policies are actually nonexistent or limited in many African countries (Gillwald, et al 2010). Bridging the above divides entails not only improving Internet access conditions (better infrastructure, high-speed service, etc.) and network coverage, training and introducing the populace with IT technologies, but also sound national digital policies. Besides, reducing the digital divide in the African continent requires taking into consideration technological, economic and political challenges.

In this endeavor, the Eritrean government should foster the process of making necessary investments and adjustments in the Internet infrastructure and systems in order to be able to meet the proper demands and needs of the citizens. Promotion of the use of the Internet in productive activities like e-government, education and business will certainly help in availability and effectiveness.

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ANNEX

Variables	Mean	Standard Deviation
Age	1.1933	0.83162
Living Condition	1.5567	0.61757
Command of English	0.7633	0.81417
Computer Skills	0.8600	0.62853
Family Members	0.1100	0.31341
Close Friends	0.1167	0.32156

Age	Frequency	Percent	Cumulative Percent
Below 21	57	19.0	19.0
Between 21 and 30	151	50.3	69.3
Between 31 and 50	69	23.0	92.3
Above 50	23	7.7	100.0
Total	300	100.0	
Living Conditions	**Frequency**	**Percent**	**Cumulative Percent**
Very good	20	6.7	6.7
Good	93	31.0	37.7
Bad	187	62.3	100.0
Total	300	100.0	
Command of English	**Frequency**	**Percent**	**Cumulative Percent**
Very good	143	47.7	47.7
Good	85	28.3	76.0
Bad	72	24.0	100.0
Total	300	100.0	
Computer Skills	Frequency	Percent	Cumulative Percent
Very good	83	27.7	27.7
Good	176	58.7	86.3
Bad	41	13.7	100.0
Total	300	100.0	
Family members	Frequency	Percent	Cumulative Percent
Yes	267	89.0	89.0
No	33	11.0	100.0
Total	300	100.0	
Close Friends	Frequency	Percent	Cumulative Percent
Yes	265	88.3	88.3
No	35	11.7	100.0
Total	300	100.0	