A BINARY LOGISTIC REGRESSION MODEL FOR THE ADOPTION OF ELECTRONIC BANKING IN AKURE, ONDO STATE*

S.A. OLUWADARE+ and O.J. KAYODE
Department of Computer Science, Federal University of Technology, Akure, Nigeria

(*Recieved*: August 2007; *Accepted*: March 2008)

Abstract

Information and Communication Technology (ICT) is fast changing the face and tempo of the banking industry in Nigeria due to the adoption of electronic banking (e-banking). Consequently, most banks, in recent years have committed substantial investment into the development of ICT. This study examined the adoption of e-banking in Akure, Ondo State with the objective of identifying the factors that influence its adoption. Three hundred customers of the major banks in Akure were randomly sampled and a structured questionnaire was administered on them. Binary regression analysis was used to estimate a model for predicting the probability of adoption of e-banking. The result showed that level of education, monthly income, occupation, type of account being operated; among others are the significant determinants of the probability of adoption. It is recommended that policy makers should address those factors that could promote the adoption of e-banking.

Key words: e-banking, adoption, binary logistic analysis.

1. Introduction

The advancement in Information Communication Technology (ICT) in recent times has introduced new ways of delivering banking services to the customer. Banks all over the world have made considerable investments in developing their ICT departments. The degree of automation or computerization has become a subject of competition with banks trying to outdo one another in a seemingly endless race. Recent advances in telecommunications and computer technologies have moved computer networks to the centre of the international economic infrastructure. Hence, bank customers have found themselves at the forefront of technology adoption. The upsurge in the use of internet has transformed global business, of which banking is a sub-sector, by facilitating instantaneous, inexpensive contact among sellers, buyers, investors, advertisers and financial institutions anywhere in the world. This development led to the evolution of electronic commerce (e-commerce) and subsequently, electronic banking (e-banking).

2. Motivation for the study

Banking is in the frontline of business activities in Nigeria today. It is perhaps, the most active sub-sector of the Nigerian Stock Exchange. E-banking being a relatively new concept in Nigeria, is gradually working its way into the hearts of individuals, banks and other financial institutions. Nigerian economy being a major role player in the West African sub-region and a front liner in Africa needs a virile and dynamic banking sector to sustain its quest for economic relevance. The benefits that derive from e-banking are enormous. Hence, there is the need to look into some of the factors that influence its adoption in Nigeria. There is the need to help position Nigerian banks in a manner that will sustain the nation's goal of becoming one of the 20 largest economies in the world by the year 2020.

3. Objectives of the study

The main objective of this study is to conduct a binary logistic analysis of the factors that influence the adoption of e-banking in Akure, Ondo State. The specific objectives are to:

a. examine the socio-economic characteristics of adopters and non-adopters of e-banking.
b. perform a comparative analysis of adopters and non-adopters of e-banking.
c. to investigate the relationship between socio-economic characteristics of respondents and adoption of e-banking.
d. to develop a binary logistic regression model for predicting the probability of adoption of e-banking.
e. to make policy recommendations based on the findings.

+ *corresponding author* (email: oluwadaresam@yahoo.com)
* Presented in part at the First Faculty of Science Conference, Obafemi Awolowo University, Ile-Ife, July 3-5, 2007.

4. Literature Review

Historical evolution of banking in Nigeria

Conventional banking system started in Nigeria in 1952. Since then, the banking industry has witnessed a lot of regulatory and institutional advances. Prior to the bank consolidation exercise of 2006, there were 89 banks with about 3017 branches nationwide as at 2004. The consolidation exercise reduced the number of banks to 25. The emerging banks though stronger and more reliable has to contend with the challenges of globilisation in order to improve their quality of service. Nigerian banks have no doubt invested much on technology; and have widely adopted electronic and telecommunication networks for delivering a wide range of value added products and services. The introduction of mobile phone in 2001, improved access to personal computers and internet services have added to the growth of electronic banking in Nigeria. However, most banks in Nigeria practice real time online banking rather than internet banking probably due to the high prevalence of internet fraud and lack of adequate regulatory framework to protect banks from the volatility of risks associated with internet banking.

E-banking

The definition of e-banking varies among different researchers. For the purpose of this study, we define e-banking based on the views of (Daniel, 1999; Mols, 1998; Sathye, 1999) which describe e-banking as electronic connection between bank and customer in order to prepare, manage and control financial transactions. E-banking can be carried out on the following platforms: (a) internet banking (or online banking), (b) telephone banking, (c) tv-based banking, (d) mobile phone banking; and (e) pc banking (or offline banking).

Adoption studies on e-banking

Adoption of innovation is an important element in a dynamic world. For instance, information and knowledge are fast replacing capital and energy as the primary wealth creating assets (Burton, 2006). Human beings respond to and/or adopt innovation at different rates. Rogers (1962) proposed a model of the diffusion of innovations that include five product or service characteristics to influence consumer acceptance of new products and services. The five product and service characteristics are relative advantage, compatibility, simplicity/complexity, observability; and triability. Several researchers have incorporated pieces of Rogers' model in empirical work that examined technological innovations (Raju, 1980; Shimp and Beardon, 1982; Price and Ridgeway, 1983; Daniel 1999; Howcraft et al 2002).

Empirical studies on the adoption of innovations have found positive relationship between usefulness and to a lesser extent, ease of use. Lockett and Littler (1997) modified Rogers' model to include the dimension of perceived risk and product involvement. The study observed that innovation attributes appear to be better predictors of adoption behaviour than personal characteristics. The Technology Acceptance Model (TAM) proposed by (Davis, 1989) incorporated the characteristics of perceived ease of use and perceived usefulness into a model of technology acceptance. Some empirical studies have also found that gender has no direct effect on adoption of technology (Taylor and Todd, 1995; Gefen and Straub, 1997). Daniel (1999) found that increases in income and education are positively related to the adoption of innovation. Most previous studies on adoption consider it as a binary variable, that is, consumers either have adopted or have not adopted the innovation. This study therefore, focuses on adopters and non-adopters of e-banking services.

5. Research Methodology

This section presents the methodology adopted in this study.

Background of the study area

The study was carried out in Akure, the Ondo State Capital, Nigeria. Ondo State is one of the 36 states of Nigeria. Akure is an indigenous town that has undergone a lot of social, political and economic transformations having served as district headquarters in the colonial days; and as provincial headquarters and state capital in the post-independent era. Hence, Akure serves as the melting point of economic, political and technological innovations of Ondo State. Akure is made up of diverse population of civil servants, professionals, artisans, farmers and students.

Sources of data

Data used for this study are derived from primary and secondary sources. Primary data were collected by means of a structured questionnaire which was administered randomly on 20 customers of each of the 15 commercial banks that have branches in Akure. In each branch, customers were sampled. Secondary data were derived from Central Bank of Nigeria Annual Reports, annual reports of some of the commercial banks and the internet.

6. Method of Data Analysis

Data collected were analysed with the aid of tables of frequency and percentage distribution, graphs and charts. Binary logistic regression was employed to derive a model for the adoption of e-banking.

Binary Logistic Regression Model

Binary logistic regression models are used to model a relationship between a dependent variable Y and one or more independent variables X. The dependent variable Y, is a discrete variable that represent choice, or category, from a set of mutually exclusive choices or categories or classification. Discrete choice models

(logit, nested logit, and probit) are used to develop models of behavioral choice or of event classification. The choice models estimated will reflect the *a priori* assumptions of the modeler as to what factors affect the decision process. Discrete choice models have been applied in various fields such as transportation, energy, marketing, telecommunications and housing, among others (Akiva et al, 1985; Knuiman et al, 1993; Council et al, 1993; Tzuoo-Ding et al, 1993; Heydinger et al, 1996; Chang et al, 1996). There are some basic assumptions or requirements about the data that need to be satisfied. These include:

a. the observations on dependent variable Y are assumed to have been randomly sampled from the population of interest. Y is caused by or associated with the X's, and the X's are determined by influences (variables) 'outside' of the model.
b. There is uncertainty in the relation between Y and X's, as reflected by a scattering of observations around the functional relationship.
c. The distribution of error terms must be assessed to determine if a selected model is appropriate.

The choice variable (response variable or classification), on the other hand, must meet the following three criteria:

a. the set of choices or classifications must be finite.
b. The set of choices or classification must be mutually exclusive; that is, a particular outcome can only be represented by one choice or classification, and
c. The set of choices or classification must be collectively exhaustive, that is all choices or classifications must be represented by the choice set or classification.

In binary logistic regression, the dependent variable is a binary or dichotomous, that is, it only contain data coded as 1 (True, success, etc.) or 0 (False, failure, etc.). The formula for predicting a logit transformation is given as follows:

$$\text{Logit}(p) = b_o + b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_kX_k \quad (1)$$

where p is the probability of presence of the characteristic of interest. The logit transformation is defined as the logged odds:

$$odds = \frac{p}{1-p} = \frac{probability-of-presence-of-characteristic}{probability-of-absence-of-characteristic} \quad (2)$$

and

$$\log it(p) = \ln[p/(1-p)] \quad (3)$$

The hypothesized, binary logistic regression model for the adoption of e-banking are as follows:

$$\text{Logit}(p) = b_o + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 \quad (4)$$

Where X_1 = sex of respondents
X_2 = Age (years)
X_3 = Marital status
X_4 = Academic qualification
X_5 = Monthly income (Naira)
X_6 = Length of usage of banking services (years)
X_7 = Occupation
X_8 = Type of account being operated

7. Data Analysis and Discussion

Socio-economic characteristics of adopters and non-adopters of e-banking

The socio-economic characteristics of adopters and non-adopters are presented in Table 1.Table 1 revealed that majority of the adopters and non-adopters of e-banking are married as 65.0% and 60.0% of adopters and non-adopters respectively are married. The modal age of adopters is 26 – 35 years while majority (66.7%) of non-adopters is above 45 years of age. This clearly shows that the adopters of e-banking are younger in age than the non-adopters. Majority of the adopters are literate with 68.6% having minimum of first degree. On the other hand, majority (55.6%) of the non-adopters had maximum of secondary school education. Also, 80.0% of the non-adopters earn less than ₦10,000 per month while 77.6% of the adopters earn above ₦10,000 per month. This shows that adopters have higher income than non-adopters.

Furthermore, 90.0% of the non-adopters have been using banking services for less than 5 years while majority (52.4%) of the adopters have been using banking services for above 5 years. Again, about 75.2% of the adopters are students and civil servants while 65.6% of the non-adopters are artisans and traders. Finally, the analysis of the type of bank account being operated revealed that 75.2% and 23.8% of the adopters operates savings and current accounts respectively. On the other hand, 90.0% and 10.0% of the non-adopters operate savings and current accounts respectively.

Empirical Results of the Binary Logistic Regression Model

The empirical results of the binary logistic regression model presented in Table 2 revealed that academic qualification, monthly income, length of usage of banking services, occupation; and type of account being operated by the respondents are the significant determinants of the probability of adoption of e-banking. All these variables are positively correlated with adoption. This implies that an increase/

Table 1: Socio-economic characteristics of respondents

Variable	Adopters (N = 210)		Non-adopters (N = 90)	
	Frequency	Percentage	Frequency	Percentage
Sex				
Male	137	65.0	54	60.0
Female	73	35.0	36	40.0
Age (years)				
15 – 25	66	31.4	2	2.2
26 – 35	114	54.3	8	8.9
36 – 45	21	10.0	20	22.2
46 – 55	7	3.3	50	55.6
Above 55	2	1.0	10	11.1
Marital status				
Single	147	70.0	63	70.0
Married	23	29.0	18	20.0
Divorced	1	1.0	9	10.0
Academic qualification				
No formal education	3	1.4	6	6.7
Secondary education	8	3.8	50	55.6
OND/NCE	34	16.2	30	33.3
HND/BSc	142	67.6	4	4.4
PGD/MSc/PhD	23	11.0	-	-
Monthly income				
Less than ₦10,000	47	22.4	72	80.0
₦ 10,000 – 20,000	66	31.4	10	11.1
₦ 20,001 – 30,000	21	10.0	6	6.7
₦ 30,001 – 40,000	18	806	2	2.2
₦ 40,001 – 50,000	18	8.6	-	-
Above ₦ 50,000	40	19.0	-	-
Length of usage of banking services (years)				
Less than 5	100	47.6	81	90.0
5– 10	71	33.8	9	10
11 – 15	19	9.0	-	-
16 – 20	13	6.1	-	-
Above 20	8	3.8	-	-
Occupation				
Student	63	30.0	1	1.1
Civil servant	95	45.2	10	11.1
Artisan	8	3.8	50	55.6
Trading	12	5.7	9	10.0
Contract	26	12.4	2	2.2
Farming	3	1.4	15	16.7
Others	3	1.4	3	3.3
Type of bank account being operated				
Savings	158	75.2	81	90.0
Current	50	23.8	9	10.0
Fixed deposit and others	2	1.0	-	-

Source: Field survey, 2006

Table 2: Empirical result of the binary logistic regression analysis

Variable	B	S.E	Wald statistic	Sig.
X_1	0.12	56.03	1.26	0.360
X_2	3.65	23.62	0.23	0.123
X_3	5.69	12.32	1.45	2.36
X_4	9.00	0.05	5.66**	0.008
X_5	2.11	0.97	7.73**	0.001
X_6	1.63	0.74	6.36*	0.041
X_7	0.71	1.26	6.32*	0.042
X_8	0.73	0.57	6.19**	0.002
Constant	12.20	37.92	4.84*	0.045
Nagelkerke R-square = 0.763 -2 Log likelihood = 28.734 Cox & Shell R Square = 0.7315 Degree of freedom = 1				

S.E. = Standard Error
* Significant at $P < 0.05$
** Significant $P < 0.01$

improvement in these variables will lead to higher probability of adoption. The Nagelkerke R-square which is 0.763 implies that about 76.3% of the variance in adoption of e-banking are jointly explained by the variables in the model. The remaining 23.7% variance is due to chance and other variables outside the control of the researcher. The Model for predicting the probability of adoption of e-banking could be specified by the following equation:

$$\text{Logit (p)} = 12.2 + 0.12X_1 + 3.65X_2 + 5.69X_3 + 9.0X_4 + 2.11X_5 + 1.63X_6 + 0.71X_7 + 0.73X_8$$

8. Policy Implications

Based on the findings of this study, adoption of e-banking is found to have positive impact on banking services. Therefore, all stakeholders and policy makers should pay particular attention to those variables that contribute significantly to the adoption of e-banking. Efforts should be made to put in place, policies and programmes that will enhance literacy, monthly income and occupational status of the citizens. Particular attention should be paid to those socio-economic variables that showed positive influence on adoption of e-banking. Finally, there is the need to improve on the interconnectivity among the populace and ICT infrastructure.

REFERENCES

Akiva, B.M. and Steven, R.L., 1985. Discrete choice analysis. Theory an application to predict travel demand. *The MIT Press, Cambridge MA*, 329-349.

Burton, P., 2006. ICTs: Tools for crime prevention. Centre for Justice and Crime Prevention, 1, 1-13.

Chang, G., Chien, C. and Cesar, P., 1996. Hybrid model for estimating permitted left-turn saturation flow rate. *Transportation research record* #1566, 54-63. National Academy of Sciences.

Council, F.M. and Stewart, J.R., 1993. Attempt to define the relationship between forces to crash-test and occupant injury in similar real-world crashes. *Transportation research record* #1419, 78-85. National Academy of Sciences.

Daniel, E., 1999. Provision of electronic banking in the UK and Republic of Ireland. International Journal of Bank Marketing, 17(2), 72-82.

Gefen, D. and Straub, D.W., 1997. Gender differences in the perception and use of e-mail: An extension to the technology acceptance model. *MIS Quarterly*. Dec., 389-399.

Heydinger, A.G., Xie, Q., Randolp, B.W. and Gupta, J.D., 1996. Analysis of Resilient modulus of dense and open graded aggregates. *Transportation research record* #1547, 1-6. National Academy of Sciences.

Howcroft, B., Hamilton, R. and Hewer, P., 2002. Consumer attitude and the usage adoption of home-based banking in the United Kingdom. The international Journal of Bank Marketing, 20(3), 111-121.

Horowitz, J.L., 1984. Testing disaggregate travel demand models by comparing predicted and observed market shares. *Transportation research record* #976, 1-7. National Academy of Sciences.

Koehne, J., Fred, M. and Mark, H., 1996. Analysis of trucker and motorist opinions toward truck-lane restrictions. Transportation research record #1560, 73-82. *National Academy of Sciences.*

Knuiman, M.W., Council, F.M. and Forrest, D.W., 1993. Association of median width and highway accident rates. Transportation Research Record #140, 70-82. *National Academy of Sciences.*

Koppelman, F., Jodi, K and Chieh-Hua, W., 1998. Nested Logit Models: Which are you using?. *Transportation Research Record* #1645, 69-75. National Academy of Sciences.

Locket, A., Littler, D., 1997. The adoption of direct banking services. Journal of Marketing Management, 13, 791-811.

McFadden, D., 1978. Modeling the choice of residential location. *Transportation research record* #673, 72-77. National Academy of Sciences.

Mannering, F., Jodi, K. and Soon-Gwan, K., 1995. Statistical assessment of public opinion toward conversion of general purpose lanes to high-occupancy vehicle lanes. *Transportation research record* #1485, 168-176. National Academy of Sciences.

Mols, N.P., 1998. The internet and services marketing – the case of Danish retail banking. Internet Research: Electronic Networking Application and policy, 10(1), 7-18.

Price, L.L. and Ridgeway, N.M., 1983. Development of a scale to measure use innovativeness. In Tybout, A.M., Bagozi, R.P. (eds), *Advances in Consumer Research*, Ann. Arbor, M.I, 679-684.

Raju, P.S., 1980. Optimum stimulus level: its Relationship to personality, demographics, and exploratory behaviour. *Journal of Consumer Research,* 7, 272-282.Rogers, E.M., 1962. Diffusion of Innovations, *The Press*, New York, NY.

Sathye, M., 1999. Adoption of Internet banking by Australian consumers: an empirical investigation. *International Journal of Bank Marketing*, 17(7), 324-334.

Shimp, T. and Beardon, W.O., 1982. Warrany and other extrinsic cue effects on consumers' risk perception. Journal of Consumer Research, 9, 38-46.

Taylor, S. and Todd, P., 1995. Assessing IT usage:the role of prior experience, *MIS Quarterly,* Dec., 561-568.

Tzuoo-Ding, L., Paul, P.J. and Chun-Zin, Y., 1993. Modelling the safety of truck driver service hours using time dependent logistic regression. *Transportation research record* #1407, 1-10. National Academy of Sciences.

Yai, T. and Tetsuo, S., 1998. Multinomial probit with structured covariance for choice situations with similar alternatives. *Transportation research record* #1645, 69-75. National Academy of Sciences.