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Multinomial Logit Model of Choices of Internet Modes in Iraq

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Abstract

Iraq is a country that has the potential to explode onto the Internet market due to the fact that much of Iraq is still largely without access to the Internet. Iraq's market has much room for corporate and individual investments in Internet technology, mainly, Internet access. However, this requires a deep understanding of the user with regards to the Internet and the market characteristics involved. This study is concerned with the users' choice of Internet mode connections in Iraq. There are several determinants of Internet use, namely, age, education, employment, utilization, and location. Through use of the multinomial logit models, these variables are analysed to define their numerical values and relevance to the Internet modes of choice in Iraq.

Keywords: Internet access, Technology choice, Technology in the homes, Broadband

JEL Codes: C25, C35, D12, L86, L96

1. Introduction

Internet access is a way for Internet users to communicate through the use of Internet links provided by the Internet Service Provider (ISP). ISPs use different technologies to allow this access. Examples of communication technologies that provide Internet access include: the public switched telecommunications network (PSTN), cable TV networks, satellite systems, and several other alternative access forms.

The Internet has diffused quickly and widely but its spread has been unbalanced within various regions and countries. The digital divide tends to become wider as (DiMaggio et

al. 2001) defines the digital divide with regards to inequalities in access to the Internet to include the following: extent of use, knowledge of search strategies, quality of technical connections and social support, ability to evaluate the quality of information, and variety of uses. Iraq, like many other developing countries is suffering from a huge digital divide in terms of Internet access compared to advanced countries. The purpose of this study is to investigate the factors influencing Internet access options in Iraq.

By drawing from theories of technology adoption, 17 factors were identified. Some of the factors are grouped into categories. For example, the age factor was divided into three groups, namely: age1, age2 and age3 (depending on the respondents' ages). The second factor, Education, was divided into four groups: education1, education2, education3, and education4 according to the individual's level of education. The third factor, Employment, was divided into four groups: unemployed, public, private, and student. The fourth factor, Intensity, was divided to four groups depending on the rate of intensity: not at all, rarely, sometimes, mostly, and always online. Finally, location was divided into five groups as follows: capital of Iraq, Middle Euphrates region, South of Iraq, The North Central Region, of Iraq, and The South-Central Region of Iraq". The Internet service users viewed on the 17 factors were gathered to discover if and how they influenced their choice of Internet access.

The main objective of this study is to better understand the Internet adoption decision. We used micro-economic theory and empirical analysis of consumer utility maximization to model how consumers decide whether or not to adopt Internet's new access technology. The consumer may be uncertain about their ability to use it. It is interesting to know what characteristics are most critical in making the adoption decision since Internet and computer literacy is an important factor with regards to Internet access. The next set of variables addressed the costs, education, employment and age factors. The more educated an individual is, the more likely they will be to have Internet access. The younger one is, the more likely they are to have high-speed Internet connection technology. Individuals with public jobs more often than not, have Internet available to them at more than one facility.

Through this analysis we sought to reveal drivers and barriers for Internet adoption in Iraq. This analysis could also suggest potential policy options for the development of Internet access. The following research question is addressed: What factors influence the choice of Internet access modes? According to (Leroux et al. 2008), there are many factors affecting Internet access modes, two of these factors are: Accessibility and Socioeconomic characters. However, modelling these mode options in cases where existing factors come into play is difficult to estimate since, the main difficulties surround the availability of data and lack of accuracy and consistency.

The rest of the study is organized as follows: sections 2 and 3 outline the conceptual background and literature review followed by the data and descriptive statistics in Section 4. Section 5 deals with the method and model Specification while also discussing estimation. Next, Section 6 will include an analysis of the results. Finally, the study will be summarized in Section 7. In closing, conclusions and recommendations will be made.

2. The Internet in Iraq

2.1 The Sources of Internet Connectivity

Kelly and Petrazzini (1997) have analysed the role of communication networks in

Internet diffusion. They found that networking technologies play a significant role in the diffusion of the Internet. Unlike many earlier studies which, considered access cost to be a significant factor influencing internet access. From the above, it is hypothesized that the diffusion of the Internet in any country that has invested more on communication networks is higher than those that invest less in this sector.

One of the main factors in when discussing telecommunication network is the telephone since the last mile of connectivity to end-users is provided by Public Switched Telephone Networks (PSTN). The last mile of connectivity is the mode of communication between an Internet user and the Internet Service Provider (ISP). Several other technologies such as "Digital Subscriber Link" (DSL) are available for this purpose; the most preferred technology is PSTN. The use of both investments on telecom infrastructure and telephone density is justified because investment in telecom is part of the institutional infrastructure that is beyond the control of individual Internet user. Whereas, access to a telephone is an individual's decision and is within their reach. Empirically, several studies (Hargittai, 1999; Kiiski and Pohjola, 2002; as well as Banji and Lal, 2005), Heshmati et al. (2013) have analyzed the role of last mile connectivity in the diffusion of the Internet. Kiiski and Pohjola (2002) used access cost as well as telephone density as a proxy of telecom variable in their study. All the above studies conclude that last mile connectivity significantly influenced Internet access.

According to Christopher (2002), geographic position theory states that, "the decreases in the cost of internal communications will be less valuable for the areas that are geographically concentrated." In addition, traditionally local area networks cannot reach over large distances, and private line services are expensive. In general, public utilities are difficult to extend to new residential areas in Iraq. This is due to its distribution system of wide and horizontal residential housing which is not economically efficient in comparison to European and Asian countries. In Korea most of the residential densities are concentrated in tall buildings and utility services can be easily reached in these areas. In contrast, geographic concentration will have the greatest impact on the adoption of access to the Internet.

2.2 The General ICT Infrastructure in Iraq

It comes as no surprise that the growth of Internet use has become a common staple in academic and business environments. Although there is no reliable data with regards to the size of the world's on-line population, estimates suggest that the number of Internet users around the world has surged from 4.4 million in 1991 to more than 600 million in 2002. Thus, the rate of global Internet access has increased from less than 0.1 per cent in 1991 to over 10 per cent of the total world population in 2002 (Wellman and Hogan, 2004).

Evidence shows that, in the past two years, there have been significant efforts made towards the reinforcement of reconstruction and development. However, sectarian tensions, violence and continued displacements of individuals in Iraq and its neighbouring countries have prevented Iraqi people from enjoying a sense of progress or even a hope for better living conditions. Daunting challenges still remain in the provision of basic services such as: respect and application of the rule of law, systematic human rights, transparency and accountability within governmental institutions and policies, and real transition to democracy and economic prosperity (Dewachi, 2006).

Before 2003, Iraq suffered from immense hardship due to continuous external conflicts, which rendered the country lagging in almost all economic and social domains, not excluding ICT. The government's involvement in mobilizing oil revenues for security and military support on the one hand and for the Oil-for-Food program on the other prevented Iraqis from acquiring the quality of life prevalent in other major oil-producing countries.

It's important to mention that until 2003, i.e., after the coalition invasion in Iraq, access to Internet was extremely limited for private use. Studies have shown that there is a high correlation between countries' levels of democracy and Internet connectivity. Iraq possessed very low levels of democracy (Bidgoli, 2003). Although security levels remain immensely low, Iraq has succeeded in developing and advancing its ICT sector particularly with respect to telecommunications. However, the IT achievements, though noteworthy, remain incomparable to advancements in telecommunication.

The war in Iraq in March 2003 marked a milestone in the liberalization of the ICT sector, particularly for telecommunications. Before the year 2003, ICT policies were either non-existent or extremely oppressive, as access to ICT by the public was considered a privilege to some and a threat to the security of the governing regime to others. The heavy- handedness of the National Computer Centre (NCC) of the Ministry of Planning, in close coordination with the Iraqi Intelligence Agency, retained exclusive responsibility for the government's IT policies by means of exacerbating security fears and threats among politicians and decision makers. (see Dewachi, 2006).

In 1999, the NCC (National Computer Centre) was detached from the Ministry of Planning and attached to the Ministry of Higher Education and Scientific Research. This move, together with the rapid development in technology, provided a long needed, but late, resting period to ministries and government agencies to independently plan their own ICT activities and applications. In 2000, the name of the NCC was changed to the Iraqi Commission for Computers and Informatics (ICCI). Soon after the invasion of 2003, ICCI was dissolved, but then resurrected in 2005. In June 2003, the Ministry of Transport and Telecommunications was split into the Ministry of Communications (MoC) and the Ministry of Transportation, (Arab Advisors Group, 2007). Unlike many countries in the region, the Iraqi government did not add "information technology" into the name of the new ministry.

2.3 Current Status of Telecommunication Infrastructure in Iraq

The war on Iraq resulted in considerable damage to the infrastructure of the Public Switched Telephone Network (PSTN), as 12 of the 14 main telecommunication switches in the capital Baghdad incurred damages and halted their services up to 50%. At the time, the PSTN was providing services to 1.1 million lines (Dewachi, 2006). Major completed projects to rebuild and enhance the PSTN are listed in the Table 1.

Table 1. PSTN Reconstruction Project

Name of Agency	Activity
USAID and the CPA	Repaired 1.200 Km of the fibre optic backbone network thus reconnecting 20 cities and 70% of the population. Installed switches at 12 sites with 240.000 lines in Baghdad. Installed 13 new switches in Baghdad. Reactivated over 215.000 subscriber lines in cooperation with MoC. Installed a satellite gateway system and provided relevant training to telecom

	engineers and technicians
Bechtel	Installed switches using Lucent technologies
Globecom	Installed an international gateway for long-distance voice, fax, and data service via satellite and restored part of the fibre–optic network spanning from north to south Iraq.
Jordan Telecom and ITPC	Installed a fibre optic line between Iraq and Jordan

However, because of terrorism acts as well as financial and administrative corruption that resulted in the lack of control over companies engaged in reconstruction of Iraq, the facts show that the reconstruction work was carried out on paper only. According to an e-Government Survey (USAID, 2005) Internet users per 100 persons was 0.14 whereas PC users was 0.83, telephone lines per 100 users around 4.00, and broadband per 100 was 0.

Regarding the Internet backbone, a national fibre optic network is being implemented with 50% having been completed as of the end of 2005 by Nortel Company. Two LAN gateways currently exist and more are being set-up. Connections to international World Wide Web cables are also en route (ITCE, 2008).

2.4 Brief Information on the SCIS Project

The State Company for Internet Services (SCIS) was founded in early 2000 and was previously an institution of the Ministry of Transportation and Communications. Now it has become one of the two companies under the Ministry of Communications to practice its activity in providing Internet service, which covers local sectors as well as areas outside the networks, and designing web sites on the international network, in addition to many other common services. After the regime's fall in 2003, important changes have taken place in the company; it now has more than 19 pops in the switches of ITPC (Iraqi Telephone and Post Company) in Baghdad, and at least 1 pop in each governorate.

The main services that the SCIS provides can be summarized in the following four categories:

First: WBBN Project. This project represents the wireless communication service (broadband project) and it is one of the most important and strategic projects that is provided by the company and considered to be the real core of the infrastructure for the electronic government project in the future. Wireless Internet service covers the needs of more than 39 governmental sites. In addition, other new governmental sites will be covered by this service. Also, the service includes Voice over Internet Protocol (VOIP) and Video Telecommunications Conference (VTC) which means that video-voice conversations can be done between two parties on the network, and with modern techniques. It will also be able to transfer video data among the network users. These services cover all governmental sites included in WBB service. The company is also planning to grant licenses to the private sector in order to provide the service to the public. In the next stage, they plan to develop and expand this project using WIMAX technology. The company has made progressive expansion and it plans to have two WIMAX networks: First, there will be a governmental network which will serve governmental offices all over Iraq. The State Company for Internet Services is responsible for managing and operating this network. Second, there will be private networks. The operator of the private sector will be contracted to provide this service to the public.

Second: Wireless. This type of network technology is considered to be one of the simplest. It is specialized and designed to work indoors as an internal network for a limited number of computers. However, this technique is found to be common for most users due to the low cost of equipment used compared with others. Thus the company finds it necessary to satisfy the needs of the users who prefer to keep the old equipment used by them without being obliged to buy new hardware for new techniques.

Third: Dial-up. This is a broadband service. The company has been able to expand this kind of service in all the working switches in Iraq via pre-paid cards which are now working on the sites of Uruk and Al-Warkaa via granting licenses for the private sector in order to provide this service to the citizens (CTM and Al-Nada companies).

Fourth: ADSL. The wire telephone lines network is considered to be widespread in city centres. Therefore, it is quite important to provide this service to the public. This service provides high speeds under specific conditions depending on the length of the copper telephone wire that reaches the customer. The company has taken initial steps to start this kind of service by supplying seven main telephone switches in Baghdad with DSL Access multiplexer and splitter equipment. There is an intensive push to join ventures with private sectors to transmit and spread the service to all governorates of Iraq.

2.5 Research Questionnaire

The objective of this study is to identify the factors that affect the consumer's choice of mode regarding Internet connection, and the nature of Internet connection in Iraq, based on the literature review. Multinomial regression analysis will be used.

3. Literature Review

The Internet has brought about a wide variety of changes in the way we conduct business, communicate with each other, carry out banking transactions, impart education, do shopping, watch videos, stream data, etc. With globalization and liberalization policies spreading across all corners of the globe, the reach and utility of Internet has indeed crossed many barriers. But at the same time with the disturbing news of online frauds, deceptive videos, data and identity thefts, the security of online transactions has also come under scrutiny from time to time.

According to Hargittai's (1999), analysis of Internet connectivity in 18 OECD countries found significance influence from competition between telecom service providers and GDP per capita on Internet access. In their study of the Chilean Internet population Mendoza and Alvarez de Toledo (1997) found that Internet users are young, male, highly-educated, and have higher income levels.

In a recent study by Wunnava and Leiter (2009), they examined social, economic, and political factors of Inter-country Internet diffusion rates. These include GDP per capita, ICT infrastructure, literacy rates, English proficiency, urbanization, and political freedom. In fact, socioeconomic and demographic determinants are important factors explaining use of computers and the Internet (NTIA, 2002).

Age is also an important variable. Older generations generally tend to have a lower propensity to adopt high-speed connection. One's educational level is an important determinant of choice, because one's level of education increases the demand for a high-speed connection increase because of high-doweled demand. Geographic location also plays a role. The closer one is to the centre of the city Internet modes and utilization

proportion increases with regards to those factors that are expected to be determinants towards the adoption and diffusion of the Internet in Iraq.

Wireless access in Iraq is still not operating at optimum levels. Recently, people who have visited Iraq have complained because their Blackberry's did not work there. Iraq still has a long way to go in terms of technological advancement, especially when it comes to wireless access.

4. The Data

As discussed in the literature review, the Internet mode of choice differed between users regarding a number of characteristics such as age, education, profession, gender, utilizations and location. Based on this, a survey was developed to collect the most relevant data that represented these aspects. Here we will introduce the data and variable definitions. Summary statistics of the data used will also be provided in order to understand why people choose different types of Internet access.

4.1 The Data Collection

Through a survey and interview process, we aimed to find proper ways to indicate that there are indeed individuals in Iraq who connect to the Internet for several reasons, and that connection to the world benefits them. It is expected that through this particular approach, understanding the different factors contributing to the access of the Internet in Iraq can be readily determined through examination and observation. (in a wider scope of consideration).

One important issue is quality of data. Data quality problems include: inaccuracies, inconsistencies, and incompleteness of data, which can be handled by confronting the problem directly and obtaining a resolution (Hood, 2008). To control the data quality, proper sampling data was gathered from various governorates of Iraq. A total of 19,800 questionnaires were distributed and 16,800 were returned; 966 questionnaires were incomplete and were therefore discarded. This yielded a total of 15,834 usable questionnaires. The questionnaire does not ask open questions. The study uses a multiple-level Likert's scale. This scale is widely used in such kind of research. Table 2 categorizes the questions used in the questionnaire.

The questionnaire contained 11 questions in total. The first six questions (Q1-Q5, Q11) asked about demographic information (Gender, Age, Education, Location, Employment, and Internet Usage), while the last five questions (Q6-Q10) are as follows: "What are the reasons why you do not have [an] Internet connection?; Purpose for use Internet service; What is the type of technology you use to connect to the Internet?; What is the cost of obtaining an Internet connection?; and What is the Internet utility rate?"

Table 2. The Iraq Internet use questionnaire

Factor	Questions	Question number	Constructed variable
Utility	What is the Intensity rate of Internet use?	Q10	Intensity
Resources	What is the technology used to connect to the Internet (modes)?	Q8	Modes
Cost	Cost of obtaining Internet connection?	Q9	Cost
Demographic factors	Gender	Q1	Gender
	Age	Q2	Age
	Location	Q11	Location

	Education	Q3	Education
	Type of work	Q4	Employment
	Do you have Internet	Q5	Internet
Efficiency	Purpose of Internet service	Q7	Purpose
	Why no Internet	Q6	No-Internet

The state company for Internet Services through its branches in different provincial locations of Iraq is illustrated in Table 3. Iraq has been divided into five regions as follows: Baghdad; Middle Euphrates of Iraq, South of Iraq, North-central Iraq, and finally South-central Iraq. Among these areas, a questionnaire was distributed to a random sample of citizens from different ages, genders, and levels of education. Data collected in April 2009 on Internet use in Iraq had a total number of 15,834 observations, asking 11 questions, and no unit observations were missing. The breakdown by gender was 9,439 males and 6,396 females. According to the Iraqi population this size (30 million in 2005) is sufficient, and in this case there is no missing data is assumed. Cities have been surveyed as below in Table 3.

Table 3. Iraqi random observations by provincial location

N.	Region	Provinces	Observations
1.	Baghdad	Baghdad	3206
2.	Middle Euphrates region	Najaf, Karbala, Babil and Wasit,	2003
3.	Southern Iraq	Maysan, Diqar and Basrah	2969
4.	Region of north-central Iraq	Anbar, Mawsil, Diyala and Kirkuk,	4045
5.	Region of south-central Iraq	Diwaniyah and Muthana	3593

4.2 Descriptions of the Variables

Questions in the survey are categorized here according to the main construct (see Appendix Table 1). In addition to demographic constructs, this study has the construct of intensity, which includes intensity rate factors. It also includes construct efficiency, which explains why the surveyor does not have Internet services. The resources construct includes the type of modes. The cost construct includes cost. These constructs in this research model are better-fitted to the aim of this study and the requirements for the Iraqi case.

The descriptions of the main factor variables are in details shown in Appendix Table 1. For better understanding of the variables we provide a description of some of these variables, for instance how the variable Age has been categorized into three group ages (12-25, 25-40, and 40+). The same rule has been applied to the Education variable which is categorized into four different education levels (primary and intermediate, high school and diploma, Bachelor's degree, and the last group is for the group of the people who hold Master's and Ph.D. degrees).

Appendix Table 2 and Table 4 show, respectively, descriptions of the statistics of the sub factors, and a summary of statistics for the main factors that were used in this research to identify the impact of those factors on the use of Internet in Iraq. However, according to the results in Appendix Table 2, it illustrates high heterogeneity while data desperation is low in general. Yet, some groups showed better heterogeneity results and much less desperation which strongly suggests the adequate use of groups in the analysis.

Table 4. Summary statistics (main factors) of the data

Variable	Mean	Std .Dev.	Minimum	Maximum
Gender	0.595	0.490	0.000	1.000
Age	1.498	0.648	1.000	3.000
Education	2.277	0.866	1.000	4.000
Employment	2.804	1.041	1.000	4.000
Internet use	0.742	0.437	0.000	1.000
No Internet use	2.944	1.120	1.000	4.000
Purpose of use	1.974	1.117	1.000	4.000
Modes	3.017	1.069	1.000	5.000
Cost	0.313	0.463	0.000	1.000
Intensity rate	2.382	0.982	1.000	4.000
Location	2.877	1.335	1.000	5.000

Based on Table 4, we can infer the following discussion and analysis of the result:

First, for Internet users: as illustrated in Figure 1 Iraqis access the Internet through identifiable procedures. In the survey performed in this study, it has been seen that there are those who use dial-up connections while others use wireless access. Female dial-up users reached 12.4 per cent while male dial-up users reached 9.4 per cent. Females who used wireless connections approached 70 per cent. Males who used wireless connection approached 80 per cent. Dial-up is a connection to the Internet using a phone. The majority of users are those who use a wireless Internet connection either through Internet cafes (the majority of males use this way), or through the delivery line from the nearest Internet cafe to the house (the majority of females use this way).

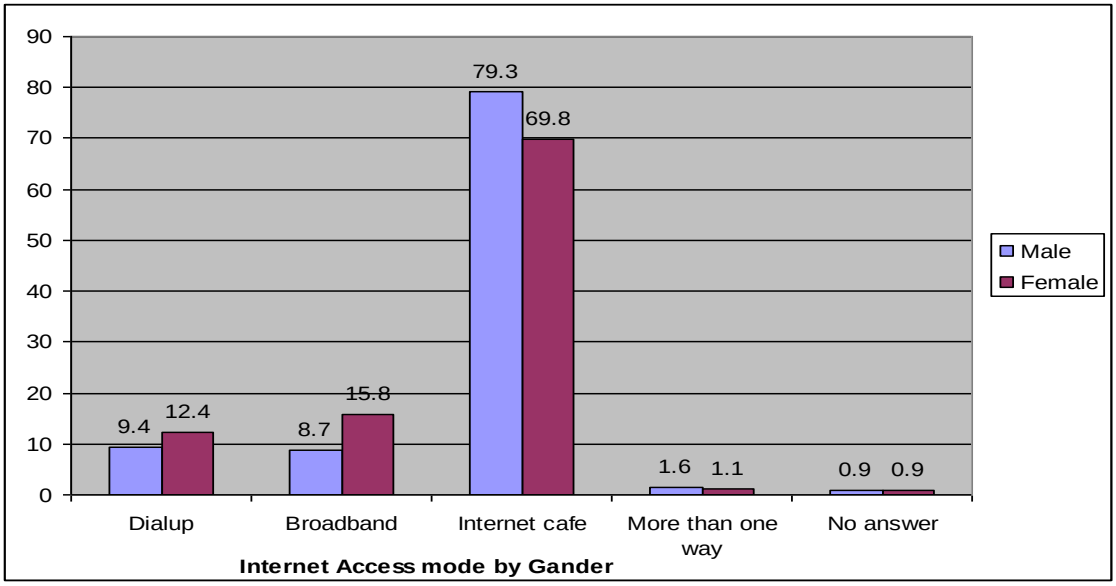

Figure 1. Internet access type by gander

In fact, Internet cafes are convenient, cheap, and an easy way to access the Internet for users with low time-use demand. The purpose of use varied among the Internet users. For females, a total of 54 per cent spend time for general search, 18 per cent for entertainment (email and chatting), and another 27 per cent of Internet users are online for special purposes. For a male a total of 58.3 per cent spend time for general search 20 per cent for entertainment (email and chatting), and another 21.4 per cent of Internet users are online for special purposes (for more details see Appendix Table 3).

Second, for universal access to the Internet: 65 per cent of Iraqis feel it is very important that everyone have access to the Internet. Another 3 per cent believe that it is somewhat important, whereas approximately 23 per cent do not believe Internet access for all Iraqi people is important at all. Most people agree that barriers to the Internet should be removed, but there is no agreement about who should be responsible for their removal. About 23 per cent do not know who should be responsible for removing barriers to the Internet. Of those who do express a view, the largest percentage indicate that individuals should be responsible for removing barriers. Slightly smaller percentages believe that the federal government should remove barriers or believe it is the responsibility of private industry such as Internet providers (Iraqi Ministry of Telecommunication, 2009).

5. Method, Model Specification and Estimation

There are different methods, parametric and non-parametric, which are used to investigate Internet use (Al-Hammadany and Heshmati, 2011; Orviska and Hudson, 2009; and Baquero-Forero, 2013). Descriptive and factor analyses are often used before the multivariate analysis. A factor analysis can also be used to investigate significant factors that have an influence on Internet modes. As a third alternative, a multiple-logistic regression analysis model is constructed. The concepts included in the models above are used to investigate the determinants of types of access to the Internet.

5.1 Method

In this study we utilized a parametric approach to estimate a model of choosing Internet modes. Since we are interested in an individual sample as an Internet access mode, in our analysis we used the logit model which is also known as discrete choice, to examine choices of Internet mode use in Iraq. It can be viewed in special cases as a general model of utility maximization. An individual is assumed to have preferences defined over a set of alternatives (modes). The model is written as below:

$$\text{U (alternative J)} = \beta_J' X_{iJ} + \varepsilon_{iJ} \quad (1)$$

$$\text{Observed Yi = choice j if Ui (alternative j) > Ui (alternative k)} \ \forall \ \text{k} \neq \text{j} \quad (2)$$

Where U refer to utility, I is the index of the observation or individual, and j is index of choices, X is a vector of explanatory or conditional variables or indicators of Internet access; β denoted the vectors of unknown parameters to be estimated; and ε is a random error term. We will examine the logit model. In this model, it is assumed that the independent variable consists of a set of individual specific characteristics, such as gender, age, education, employee, etc. These are the same for all the choices. The observational setting is the individual's choice among a set of alternatives, where it is assumed that the determinant of the choice are the characteristics of the individual. The models with dichotomous dependent variables are estimated using logit model and based on the specification discussed in the method section above, the choice probability is written as:

$$\text{Prob [choice j]} = \text{Prob } [U_j > U_k], \forall k \neq j \quad (3)$$

This means that the probability of selecting choice j will be the same as selecting the probability of the utility of rank j that is greater than utility rank k, in condition that the utilities specified are not equal.

5.2 Model Specification and Estimation

Based on the same method and findings in the literature, we specify a model to identify the determinants of Internet mode choices and to estimate each determinants impact on the choice of the probability of the modes. The model is specified as:

$$Y_i = f(X_{1i}, X_{2i}, ..., X_{Ji}) \tag{4}$$

Where X and J are J indicators or vectors of indicators of Internet modes. The indicators here are age, cost, education level, employment, gender, intensity rate of Internet use and location. After appending an error term the model specification is as follows:

$$Y_i = \alpha_0 + \beta_{Gen} Gen_i + \beta_{Cos} Cos_i + \sum_{j=1} \beta_j Age_{ji} + \sum_{j=1} \beta_j Edu_{ji} + \sum_{j=1} \beta_j Emp_{ji} + \sum_{j=1} \beta_j Ins_{ji} + \sum_{j=1} \beta_j Loc_{ji} + \varepsilon_i \tag{5}$$

Where Edu, Emp, Ins and Loc represent education level, employment, intensity rate and regional location of users. The number of categories in each group of variables (J) may differ by the way the respective variable category is defined.

Researchers commonly use the logit model in discrete choice analysis. However, Internet diffusion cannot be captured through a single econometric equation. One examines a multinomial logit model—which is an extension of the basic binomial logit model—to estimate the unknown parameters of β_j and define the factors that influence Internet mode in Iraq. However, since the dependent variable is not a continuous variable, we are not able to use the ordinary least squares (OLS) estimation method.

Accordingly, the model is written as:

$$\text{Prob [choice j]} = \frac{\exp(\beta_j' X_t)}{\sum_{m=1}^{J} \exp(\beta_m' X_t)}, J = 0, ..., J, \tag{6}$$

β represents the parameters that are estimated, while all *X*'s represent variables influencing the decisions to adopt access modes to the Internet. (Note that, for the i^{th} individual, Y_i is the observed outcome and X_i is a vector of explanatory variables).

5.3 Model Testing

To test how the specified model fit to explain the variations in the data surveys, we will present Table 5 containing the frequencies and percentage shares of Internet modes:

Table 5. Performance of the model, frequency and shares of alternative modes

	Predicted alternative (modes)					total
Actual alternative (modes), Freq.	0	1	2	3	4	
0	2,273	0	0	212	0	2,485
1	167	0	0	1,371	0	1,538
2	245	0	0	1,576	0	1,821
3	371	0	0	9,418	0	9,789
4	13	0	0	188	0	201
Total	3,069	0	0	12,765	0	15,834
Actual alternative (modes), %	0	1	2	3	4	
0	74.00	0	0	2.00	0	
1	5.50	0	0	11.00	0	
2	10.00	0	0	12.40	0	
3	12.00	0	0	73.77	0	
4	0.42	0	0	1.50	0	

From Table 5, it shows that Internet caf és are the most suitable way for Iraqi people to get connected. However, the highest frequent alternative has no connection because the majorities of the masses do not have Internet access. Secondly, we will now calculate alternative predictive values using the formula [(2273+9418)/ 15834]*100= 73.8%, this indicates that 74% of our data fits with the model, explained correctly by the model.3.6 in the Analysis of Results

According to the results illustrated in the Table 6, the model with the highest RHO (ρ=0.267) indicates the best fit with data (McFadden, 1974)[1], furthermore, LR Test equal (LR=9470.76) and its critical values (p=0.05) =27.59[2] which indicates that the effect of the model specification is statistically significant (Greene, 2008). In more detail, the calculated LR value in this model was larger than the critical value in 5% level of significance, which indicates that the null hypothesis (the model with only intercept) is rejected and the explanatory variables used in the model are all jointly significant.

The summary results of the Multinomial logit analysis for our model in equation (5). Table 6 is summarizing the regression results for our model, by using degrees of significance. First, the probability when y is equal to one means the mode choice is dial-up; education 4, employment 4, intensity 2, intensity 3, intensity 4, and location 2 have positive relations and very high statistical significance in the Internet mode (dial-up connection). In contrast, the intercept has a negative value and a very high statistical significance in the Internet mode (dial-up connection). Furthermore, Age 3 has a negative value and a very high statistical significance in the Internet mode. Age 2 has a negative value and is statistically less-significant in this technology of Internet access. These indicate that the middle and higher age groups are less prone to use Internet via Dial-up connections.

In an in-depth look at one result, the third column of Table 6, shows the coefficient estimate for the Internet access via broadband technology. The variables education 4, employment 4, intensity 2, intensity 3 and intensity 4 have positive values and have high statistical significance, while gender (male option), Age 3, education 2 and Education 3 have negative values and statistically strong significant effects on the adoption rate of Internet access through broadband. The fourth column presents coefficient estimates of Internet access via Internet cafe. In this case, the variables (Gender, Education 4, Employment4, Intensity 2, Intensity 3 and Intensity 4) have positive values and high statistical significance, while variables of cost and Age 3, have negative values and are highly statistically significant. The fifth column presents coefficient estimates of access technology by using more than one way (this alternative is mutually exclusive and can be included) given the variables of gender, Employment 4, Intensity 2, Intensity 3, and Intensity 4, which have positive values and high statistical significance—while the variable Education 4 has a positive value and is statistically less- significant. The variable employment 2 has a negative value and is also statistically less-significant.

[1] RHO=$1-\frac{LL1}{LL0}$ where LL1= Unrestricted log likelihood and LL0 = Restricted log likelihood functions.

[2] LR=2{LL (1)-LL (0)} where LL (1) = Unrestricted log likelihood and LL (0) = Restricted log likelihood functions.

Table 6. Maximum likelihood logit model parameter estimates of Internet mode on different probabilities

Variable	Probability (y=1)" Dialup"		Probability (y=2)" Broadband"		Probability (y=3)" Internet café"		Probability (y=4)" More than one way"	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Constant	-2.790***	-15.600	-2.100***	-12.737	-2.148***	-14.502	-4.846***	-12.119
Gender (male=1)	-0.035	-0.393	-0.457***	-5.482	0.385***	4.897	0.622***	3.557
Cost	-0.172	-1.869	-0.098	-1.110	-0.321***	-3.955	-0.063	-0.381
Age2	-0.282**	-2.382	-0.021	-0.187	-0.180	-1.723	-0.101	-0.488
Age3	-0.469***	-2.783	-0.549***	-3.205	-0.481***	-3.300	-0.296	-0.974
Education2	-0.150	-1.388	-0.552***	-5.496	-0.158	-1.718	-0.469	-1.905
Education3	-0.200	-1.374	-0.453***	-3.283	0.188	1.502	0.384	1.426
Education4	0.926***	3.972	0.706***	3.079	1.096***	5.098	0.813**	2.133
Employment2	0.154	1.030	-0.110	-0.747	-0.120	-0.942	-0.591**	-2.138
Employment3	-0.269	-1.563	0.255	1.556	-0.033	-0.234	-0.486	-1.606
Employment4	0.662***	4.678	1.061***	7.802	0.688***	5.786	0.030	0.111
Intensity2	4.165***	34.548	4.111***	36.155	4.982***	50.254	4.138***	12.956
Intensity3	5.556***	22.882	5.480***	22.890	6.716***	29.275	5.874***	14.932
Intensity4	5.841***	17.354	5.637***	16.857	7.209***	22.199	7.115***	15.932
Location2	0.370***	2.811	0.139	1.121	0.210	1.815	-0.128	-0.548
Location3	0.141	1.006	-0.182	-1.357	0.164	1.337	-0.171	-0.704
Location4	0.101	0.788	-0.199	-1.630	0.0125	0.111	-0.440	-1.907
Location5	0.067	0.434	-0.176	-1.200	0.209	1.564	-0.545	-1.768
RHO (ρ)=	0.267							
LRT	9470.76							
Critical value	$\chi 2$=27.59							

***Denotes statistical significance at the 1% level (two-sided test).

**Denotes statistical significance at the 5%level (two-sided test).

From the above discussion, it's obvious that the entire amount of significant coefficient estimates could make one hypothesize that the more a consumer has, the more likely that consumer is to adopt Internet access. Students and highly-educated users are more likely to access the Internet through Internet cafés; utility rates have significant effects on Internet access in all types of modes, which mean there is potential desire to use all Internet access technology. The problem with Internet availability and infrastructure (as shown in variables Location 3, Location 4 and Location 5) does not appear to have any significant effect on the adoption rate. The age variable coefficient is a significant negative value indicating that, "ceteris paribus," and older consumers are less likely to adopt Internet access. Cost also appears to have a significant impact on the adoption decision. To better interpret this information based on the marginal effects from estimation of multinomial logit model of Internet modes, we will include in the next section the expected probability of dependent variable (modes) of adoption for Internet access.

5.4 Heteroscedasticity

In order to be consistent, we attempted to estimate the models assuming heteroscedasticity. However, we did not apply heteroscedasticity for multinomial logit model, because in parametric discrete choice models, variance functions are not identified in principle because the variance functions get divided into the mean function and the ratio ($x'\beta/e^{z\gamma}$) can be linearly approximated. That is, a "crude" mean function divided by a "crude" variance function cannot be identified from a "detailed"[3] mean function. The final estimation result in this chapter is thus based on homoscedasticity assumption.

6. Marginal Effects of Characteristics Category

The concept of marginal effect is well defined by Wooldridge (2006) as, "Is the effect on the dependent variable that results from changing an independent variable by a small amount". Thus, we will interpret the effects on Internet use with respects to incremental changes in our independent variables such as education, age, gender, cost, employee categories, etc. Our logit model includes 17 independents dummy variables (see Table 7). The table presents partial output from the logistic regressions. The sample includes 15,835 respondents with valid data on Internet use. It is used to identify which of the coefficients differ significantly from zero showing impacts on Internet use.

As shown in Table 7, the first column 'Y=1' (Dialup connections), for gender, the logistic regressions coefficient for male is equal to -0.029, the interpretation is that males have a lower probability of having Internet by 0.029. The gender divide in Internet use by dialup connections (home telephone) is attributed to culture, availability, and cost factors. Moreover the logistic regressions coefficient for Education 3 (B.Sc. category) is -0.030, relative to the Education 1 (Primary and intermediate treated as the "Base category"). Education 3 has a 0.030 lower probability of having Internet and using it (y=1). The poor in Internet access via dial-up technology is attributed to Weakness in infrastructure (home

[3] Lee, M.L. (2009), "Micro-Econometrics Methods of Moments and Limited Dependent Variables", Second Edition, Department of Economics, Korea University.

phone), lack of electricity and cost factors. But for job type, the Employment 2 (Public sector), the logistic regressions coefficient is 0.029 relative to the Employment 1 (Unemployed serving as "Base Group"). The results suggest that Employment 2, has a 0.029 higher probability of having/using Internet (y=1), successively. Employment affects positively Internet access and use, the areas where Internet service via dialup technology are available (the telephone communications are available in most of the Iraqi state institutions, and where it was re-fixed with help of coalition forces). Moreover it is free for the staff.

The logistic regressions coefficient for Intensity 2 (intensity rate rarely or sometimes), Intensity 3 (intensity rate most of the time) andIintensity 4 (intensity rate of always being online) are -0.052, -0.076 and -0.092 respectively, relative to the intensity 1 (intensity rate not at all). Intensity 2, intensity 3, and intensity 4 have 0.052, 0.076 and 0.092, and have lower intensity rates of Internet use. The reason being, if this kind of Internet access in available, the quality is very week in terms of speed, availability, reliability and productivity.

For the second column in the same table 'Y=2' (Broadband connections), for gender, the logistic regressions coefficient for male is equal to -0.092, the interpretation of males have a lower probability of having Internet by 0.092, there is a high female demand for this type of connection because of culture and security situations .Moreover the logistic regression coefficient for Age 2 is 0.019 (25 to 40) relative to Age 1(Less than 12 to 25 treated as the "Base category"), Age 2 has a 0.019 higher probability of having Internet and using it when the mode's type is broadband. For Education 2 (high school and diploma categories), Education 3 (B.Sc. category) and Education 4 (High diploma, M.Sc. and Ph.D. categories) the logistic regression coefficients are: -0.046, -0.068 and -0.037 respectively, relative to Education 1 (Primary and intermediate treated as the "Base category"). Education 2, Education 3 and Education 4 categories have 0.046, 0.068 and 0.037 lower probability of having Internet and using it (y=2). The effect is a decreasing function on the level of education.

For job type, the Employment 3 (private sector) and Employment 4 (student), the logistic regression coefficients are 0.038 and 0.048 respectively, relative to Employment 1 (Unemployed serving as "Base Group"). The result suggest that Employment 3 and Employment 4 (0.038 and 0.048) have higher probabilities of having/using Internet (y=2), successively. Employment in the private sector and students affect positively the Internet access and use. The interpretation shows that whether the individual works in the private sector or is studying they are willing to use this kind of connection if it is available (putting aside the cost for many reasons). The logistic regression coefficients for Intensity 2 (intensity rate rarely or sometimes), Intensity 3 (intensity rate mostly) and Intensity 4 (intensity rate of always being online) are -0.065, -0.094 and -0.129 respectively, relative to intensity 1 (intensity rate not at all, treated as the "Base category"). Intensity 2, Intensity 3 and Intensity 4 have 0.065, 0.094 and 0.129 showing lower intensity rates of Internet use. This is attributed to the service quality and not the continued presence of electricity).

For locations the logistic regressions coefficient for Location 3 (Southern Iraq), Location 4 (Region of north-central Iraq) and Location 5 (Region of south-central Iraq) are -0.038, -0.025 and -0.040 respectively, relative to location 1 (Baghdad, treated as the "Base category"). Location 3, Location 4 and Location 5 have 0.038, 0.025 and 0.040 showing a

lower probability of Internet access through Broadband. This is attributed to the infrastructure regarding communications in Iraq as they are generally poor, due to the negligence of the former regime having engaged in wars, which is another reason to destroy the communications infrastructure in Iraq. It can also be noted through the results of our analysis that Baghdad is relatively better than the rest of the provinces of Iraq with regards to home telephones. Finally, the cost factor has positive logistic regression coefficients that mend this type of mode because it is expensive.

For the third column in the same table 'Y=3' (Internet café connections), for gender, the logistic regression coefficient for males is equal to 0.123, the interpretation is that males have a higher probability of having Internet by 0.123. The gender divide in Internet use is attributed to culture, employment and security factors. Cost has negative logistic regression coefficient. The interpretation is that the cost of using the Internet via Internet cafés is cheap compared to other types of connections.

For Education 2 (high school and diploma categories), Education 3 (B.Sc. category) and Education 4 (High diploma, M.Sc. and Ph.D. categories) the logistic regression coefficients are 0.035, 0.096 and 0.078 respectively, relative to the Education 1 (Primary and intermediate treated as the "Base category"). Education 2, Education 3 and Education 4 have 0.035, 0.096 and 0.078 show higher probability of having Internet and using it (y=3). This can be attributed to an increase in the level of education.

The logistic regressions coefficient for intensity 2 (intensity rate rarely or sometimes), intensity 3 (intensity rate mostly) and intensity 4 (intensity rate always online) are 0.271, 0.373 and 0.042 respectively, relative to intensity1 (intensity rate not at all treated as the "Base category"). Intensity 2, Intensity 3 and Intensity 4 have 0.271, 0.373 and 0.042 showing higher intensity rates of Internet use. This is attributed to their availability, suitability, and relative speed when compared to other types of modes. Also, the availability of electricity through private generators helps to increase intensity rates. This is a factor when regarding Internet divide as many females are not allowed to visit these areas due to culture and security reasons within Iraq.

For locations, the logistic regression coefficients for Location 3 (Southern Iraq) and Location 5 (Region of south-central Iraq) are 0.041 and 0.060 relative to Location 1 (Baghdad, treated as the "Base category"). Location 3 and Location 5 have 0.041 and 0.060 show a higher probability of having the use Internet via Internet café due to its availability. Illegal Internet connections in some provinces within Iraq are higher than legal connections).

Table 7. Marginal effects from estimation of logit model of Internet modes: discrete probabilities

Variable's name	Y=1"Dialup"		y=2"Broadband"		y=3"Internet café"		y=4"More than one way"	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Constant	-0.073***	-4.916	0.011	0.764	0.027	1.206	-0.035***	-7.386
Gender (male=1)	-0.029***	-4.954	-0.092***	-15.306	0.123***	14.613	0.005***	2.660
Cost	0.010	1.662	0.021***	3.385	-0.043***	-4.853	0.002	1.327
Age2	-0.014	-1.857	0.019**	2.375	-0.010	-1.012	0.001	0.343
Age3	0.001	0.014	-0.010	-0.743	-0.007	-0.388	0.002	0.644
Education2	0.007	0.842	-0.046***	-5.689	0.035***	3.002	-0.003	-1.132
Education3	-0.030***	-2.958	-0.068***	-6.831	0.096***	6.788	0.004	1.378
Education4	-0.007	-0.536	-0.037***	-2.803	0.078***	4.234	-0.002	-0.538
Employment2	0.029***	2.543	-0.031	-0.245	-0.022	-1.347	-0.006	-2.002
Employment3	-0.029	-2.232	0.038***	2.875	-0.003	-0.198	-0.006	-1.691
Employment4	0.005	-0.455	0.048***	4.085	-0.011	-0.710	-0.009***	-2.715
Intensity2	-0.052***	-4.726	-0.065***	-5.976	0.271***	15.022	-0.006	-1.412
Intensity3	-0.076***	-6.262	-0.094***	-7.780	0.373***	19.012	-0.004	-0.920
Intensity4	-0.092***	-7.047	-0.129***	-9.671	0.042***	20.616	0.006	1.763
Intensity2	0.019	2.198	-0.009	-1.076	0.001	0.077	-0.004	-1.641
Intensity3	0.004	0.463	-0.038***	-3.998	0.041***	3.107	-0.003	-1.297
Location4	0.013	1.565	-0.025***	-2.902	0.016	1.382	-0.005	-2.113
Location5	-0.006	-0.622	-0.040***	-3.742	0.060***	4.018	-0.008**	-2.413

***Denotes statistical significance at the 1% level (two-sided test). **Denotes statistical significance at the 5%level (two-sided test).

For the fourth column in the same table 'Y=4' (More than one way). The logistic regressions coefficient for Education 4 (High diploma, M.Sc. and Ph.D. categories) is -0.009, relative to the Education 1 (Primary and intermediate treated as the "Base category"). Education 4 has a 0.009 lower probability of having Internet and using it when the mode type is more than one way; this is attributed to its reliability. Moreover the logistic regression coefficient for Location 5 (Region of south-central Iraq) is -0.008, relative to Location 1 (Baghdad, treated as the "Base category") Location 5 has a 0.008 lower probability of having the use of Internet via more than one way. This is attributed to its availability (lack of home phones in all Iraqi Regions relatively compared with Baghdad).

7. Summary, Conclusion, and Recommendation

This study aimed at identifying and analysing the factors that have influenced the diffusion of Internet access in Iraq. The study uses data from the 2009 period. Different indicators were used to investigate the role of each in influencing the use of the Internet in Iraq. As was seen from the data, depending upon education and location, people were influenced as to how they were going to access the Internet. Also, certain parts of Iraq tended to prefer specific modes of the Internet. The most frequent alternative to any modes of Internet usage is to have Internet access via Internet café—which is not a very viable but a possibility nevertheless.

In the advent of the many challenges Iraq faces, becoming a technologically advanced nation should be one of Iraq's top priorities. With better access to the Internet and the information available on the World Wide Web, people will have more opportunities to educate themselves and become more informed. As more Iraqis people become educated, they will want to have access to the Internet. As a result, this will increase the number of Internet users in Iraq, thereby making Internet usage skyrocket. Just as Asia Cell is one company whose stock is ready to explode on the international scene, Iraq's telecommunications market is one item that needs to be stimulated in order to present a huge investment opportunity (Asia, 2009).

Internet access is no doubt a key recovery tool for Iraq and has huge market potential for investors .Iraq's ability to be competitive in the future will be more dependent on how they insert their telecommunication infrastructure and how they can increase the number of people who have access to the web. Iraq has great potential that has yet to be tapped into in order to make it one of the great competitors in the Middle East within the technology sector. Besides the traditional techniques to do so, it is hoped that the advancement in technology will help serve for a better future in a country that was once ravaged by war.

In conclusion, these factors which influence Internet access in Iraq are (for a majority) fluid variables subject to change in the future. Iraq has a wealth of untapped resources that can be harnessed in order to secure its place in the 21st century with regard to Internet access and wireless communications. Suggested recommendations for Iraq include: the successful installation of broadband and wireless towers all over the country; the introduction of wireless capabilities for phones such as the Blackberry; and increased opportunities for Internet access across the nation, regardless of peoples' social locations (age, sex, location, education, and utilization of the Internet). If these suggestions are taken into account, it is very possible that Iraq will be a major contender in the future in terms of being a technologically superior and

technologically advanced nation.

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Appendix

Appendix Table 1. Description of the main variables and their classifications

Variable's name	Description	Category
Gender	0 for male and 1 for female	Demography
Age1	Less than 12 to 25, By years	Demography
Age2	25 to 40, By years	
Age3	More than 40, By years	
Education1	Primary and intermediate	Demography
Education2	High school and diploma	
Education3	BSc	
Education4	High diploma, MSC and PhD	
Employment1	Unemployed	Demography
Employment2	Public	
Employment3	Private	

Employment4	Student	
Internet	0 if he has Internet and 1 do not have Internet	Demography
Location1	Baghdad	Demography
Location2	Middle Euphrates region	
Location3	Southern Iraq	
Location4	Region of north-central Iraq	
Location5	Region of north-central Iraq	
No-Internet1	Do not know how to use	Efficiency
No-Internet2	Not available	
No-Internet3	economic reasons	
No-Internet4	No answer	
Purpos1	General search	Efficiency
Purpos2	Special purpose	
Purpos3	Entertainment and Mail and chatting	
Purpos4	No answer	
Modes1	Dialup	Resources
Modes2	Broadband	
Modes3	Internet cafe	
Modes4	More than one way	
Cost	Costly	Cost
Suitable	Suitably	
Intensity1	Not at all	Intensity rate
Intensity2	Rarely or sometimes	
Intensity3	Mostly	
Intensity4	Always online	

Appendix Table 2. Descriptive statistics of various characteristics of Internet user

Variable	Mean	Std. Dev.	Variable	Mean	Std. Dev.
Age1	0.586	0.492	Purpos3	0.169	0.375
Age2	0.328	0.469	Purpos4	0.147	0.354
Age3	0.850	0.278	Modes2	0.115	0.319
Education1	0.178	0.383	Modes3	0.618	0.485
Education2	0.462	0.498	Modes4	0.126	0.111
Education3	0.262	0.439	Modes5	0.156	0.363
Education4	0.967	0.295	Cost	0.313	0463
Employment1	0.968	0.295	Intensity1	0.193	0.395
Employment2	0.368	0.482	Intensity2	0.399	0.489
Employment3	0.168	0.374	Intensity3	0.236	0.424
Employment4	0.366	0.481	Intensity4	0.170	0.375
No-Internet1	0.146	0.353	Location1	0.202	0.401
No-Internet2	0.219	0.413	Location2	0.226	0.418
No-Internet3	0.178	0.383	Location3	0.187	0.390
No-Internet4	0.455	0.498	Location4	0.256	0.436
Purpos1	0.489	0.499	Location5	0.126	0.332
Purpos2	0.193	0.395			

Appendix Table 3. Frequency distribution of Internet modes in Iraq

Modes use by Female		Modes used by Male	
Gender #:			
Female	4126	Male	7637
Age %:			
Less than 12 to 25	59.9	Less than 12 to 25	54.4
25 to 40	33.1	25 to 40	36.7

More than 40	7.1	More than 40	7.9
Education %:			
Primarily and intermediate	12.7	Primarily and intermediate	12.4
High school and diploma	43.6	High school and diploma	46.9
BSc	31.4	BSc	28.6
High diploma, MSC and PhD	12.6	High diploma, MSC and PhD	12
Employment %:			
Unemployed	6.5	Unemployed	6.7
Public	37.7	Public	40.7
Private	14.3	Private	19.9
Student	41.5	Student	32.6
Purpose for use Internet %:			
General search	54.1	General search	58.3
Special purpose	26.8	Special purpose	21.4
Entertainment Mail and chatting	18	Entertainment Mail and chatting	19.7
No answer	1.1	No answer	1.1
Modes %:			
Dialup	12.4	Dialup	9.4
Broadband	15.8	Broadband	8.7
Internet caf é	69.8	Internet cafe	79.3
More than one way	1.1	More than one way	1.6
No answer	0.9	No answer	0.9
Cost of obtaining Internet %:			
Costly	65.3	Costly	70.3
Suitable	34.7	Suitable	29.7
Intensity rate for Internet use			
Not at all	0.8	Not at all	1.1
Rarely or sometimes	45.6	Rarely or sometimes	45.4
Mostly	29.8	Mostly	31.6
Always online	23.5	Always online	21.9
Location %:			
Baghdad	28.9	Baghdad%	15.7
Southern Iraq	18.8	Southern Iraq	25.1
North-central of Iraq	22.3	North-central of Iraq	27
South-central of Iraq	13.4	South-central of Iraq	11.7
Middle Euphrates	16.7	Middle Euphrates	20.5