Evaluationof Determinants on Number of Various Information Equipment at Households in Turkey

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Abstract

Purpose-*Thepurpose of thispaper is topresentthe factors that were effective on number of various information equipment at the households.****Design/methodology/approach-****Poisson regresion analysis was used in this paper. This paper usecross-section data belonging to 9763 households in the Household Information Technologies Usage Research belonging to year of 2014 that was made by Turkey Statistical Institution.****Findings-****According the results that were obtained, it positively affected number of the information equipment if there was facility for internet access at the household. There was a strong correlation between annual income and number of various information equipment. As annual income increases, number of various information equipment also increases. Number of various information equipment at the households in other sub-regions were much more than the provinces located at the sub-region of TRC (Gaziantep, Adıyaman, Kilis, Sanlıurfa, Diyarbakır, Mardin, Batman, Sırnak, Siirt). When compared a household with two persons, it decreased number of various information equipment if number of the individuals in the household was 7 and upper.****Originality/value-****Thispaper is thefirstattempttoanalyzefactorsaffected on number of various information equipment at the households in Turkey.*

Keywords: Information Equipment, Poisson, Regression, Marginal Effect, Count Data

1. Introduction

Information and communication technologies (ICT) are more commonly referred as information technologies (IT) (Alwahaishi 2013). Information technologies, is a term that is used for defining the technologies allowing for effectively and efficiently making the procedures such as recording and storing the data in the abstract, producing information through subjecting a specific procedure period and accessing, storing and transferring these information that have been produced. Information technologies, include calculating and communication technologies based on the micro-electronic that makes obtaining, processing, storing and distribution of audio, pictorial, textual and numerical data. Within this frame, fax, micrographic, telecommunication, document filling and preparing machines and printing machines, etc as mainly computer and input and output hardware that support these are the hardware taking place within the term of information technologies (Güleş 2002). Information technologies has become very important at production processes especially since beginning of 1980s and it is one of the corner stones of today's community. It has a big effect on our professional and private life and at the same time, it has become one of the most important determinants of economic growth (Saidi *et al.* 2015).

Along with fast increasing technological developments and changing human needs, information technologies has spread to so many fields of social life especially such as education, health and business world and as a consequence of that, acceptance ratio of information technology equipment such as telephone, mobile phone and computer has been on increase at the community and use of these equipment has become widespread. While information technology equipment provides efficiency increase at so many fields when used right, it also bring along environmental pollution with increased technological improvements and consumption speed.

The reason of that why we focused on households being main cornerstone of our community in our study that we want to present a viewpoint from a wider perspective. In the literature, it is possible to come across with the studies that were applied to more specific areas such as tourism, health, business life, environmental effects and education(Gupta 2012; Kijsanayotin *et al.* 2009; Gatautis 2015; Omar *et al.* 2012; Malapile and Keengwe 2014;Putri and Hudirarto 2015;Agbetuyi and Oluwatayo 2012; Fraige*et al.* 2012; Roupa *et al.* 2010).

The object of this study was to detect the aspects that were determinant at number of various information equipment available at the households with poisson regression analysis by using cross-section data belonging to 9763 households in Household Information Technologies Usage Research of belonging to 2014 that was made by Turkey Statistics Institution (TUIK). As the variable of number of various information equipment available at the households take integer number values between 0 and 8 for every household, it is a dependent variable that is in conformity with poisson regression model.The rest of the paper is organized as follows: The next section exhibits literature review. Section 3 introduces the material and method. Section 4 presents application results. And, Section 5 delivers a discussion of the findings.

2. Literature review

There are so many academic studies that were carried out as relevant to information technology and equipment at the households.In a study that was carried out in Thailand, it was stated that ratio of the households at which television and radio were available was 96.3% and 58%, respectively and ratio of the households at which there was internet connection was 9.5%. Ratio of land telephone per every 100 households was 22.1%.Ratio of the individuals who use computer, internet and mobile phone was 29.3%, 29.3%, 20.1% and 56.8% (Santipaporn 2010).Grzywińska-Rąpca (2015) assess the level of the use of modern technology in households. In specific studies, the correlation between the developments in information and communication technologies and growth (Kretschmer 2012; Jorgenson and Stiroh 1999; Jorgenson 2001) and correlation between number of information equipment available at the households and electric consumptions (Papachristos 2015; Djordjevic *et al.* 2013) were examined.Urhuogo *et al.* (2013) use Theory of Constraints (TOC) improvement questions to measure how employees' demographics influence their adoption of various Information Technology Equipments (ITEs) in organizations.

There are also academic studies that conducted theoretical and practical the use of information technology and acceptance (Venkatesh *et al.* 2012; Alwahaishi and Snasel 2013; Agarwal 2000; Stroade and Schurle 2003; Verdegem and De Marez 2011). Venkatesh (1996) offers a theoretical model of household-technology interaction, introducing two key constructs -the social space and the technological space--that define the main parameters of household-technology interaction. Moghaddam(2010) focuses primarily on gender gap and attempts to present computer and internet usage by gender throughout the World on the information technology. Gender, culture is also an important factor in the adoption of information and communication technology among different nations. In a study that was carried out in the previous years, it was detected that gender differences were significant on use of information technologies (Reinen and Plomp 1997). Also regional differences affect use of information technologies.Being in the West of Turkey, increases the probability of using online activities that require relatively advanced skills such as searching information and e-banking, while the probability of using time-required entertaining activities is higher for the individuals in the East (Köksal and Anil 2015).

3. Materialandmethods

3.1. Poissonregression

In the analysis of data obtained as a positive integer, because transformations used to ensure the normal distribution assumption is inadequate, Poisson regression analysis that mostly based on the exponential distribution family is used. Poisson regression is the second generalized linear model after logistic regression. When there is a data stated with number of dependent variable formations in other words there are number of the events that occur at definite time or place, they are used at the analysis of dependent variable obtained based on counting.At Poisson regression analysis, generally tables that are grouped according to definite categories are used as data.

It is required that the cell values at these tables will be a data indicating a definite specification and number of formation. At analysis of the data that these kind of tables form, logarithmic linear models are used. Poisson regression is one of these logarithmic linear models (Cameron and Trivedi 1998). Under the assumption of that mean and variance for Poisson distribution is equal, Poisson regression model was examined in this study.

At Poisson distribution, the case of that excessive spread and variance is smaller than the mean in case variance is bigger than mean is referred as spread(Cox 1983).
Poisson regression model;

$$p(Y;\mu) = \frac{e^{-\mu}\mu^{Y}}{Y!}, Y = 0,1,...,$$

Generalized linear model is to be as stated below:

$$p(Y;\mu) = \frac{e^{-\mu}\mu^{Y}}{Y!}, Y = 0,1,...,$$
$$= exp\left[y_i ln(\mu_i) - \mu_i - \ln(y_i!)\right]$$

μ at the formula is parameter of the distribution. This parameter may be changed with interpretive variables x of regression model that is expressed with observed heterogeneity between the units. Mean and variance of Poisson distribution is μ equal. μ_i here is stated below(Cameron and Trivedi 1986):

$$E(y_i / x_i) = \mu(x_i, \beta) = \mu_i, i = 1,...,n$$
$$E(y_i / x_i) = \mu_i = \exp\left(x'_i \beta\right)$$

The case of that mean and variance of dependent variable is equal is generally achieved at Poisson models and more the cases of that variance is bigger than mean are seen. In these cases, negative binomial regression is applied. Negative binomial regression is used as an alternative to poisson regression. Then these two methods conform to model by using same connection function (log). When Poisson and Negative Binom regression are applied to data set, sometimes deviation criteria is smaller at the consistency done with Negative Binom (Lawless 1987). Distribution of dependent variable is changed with Negative Binom. Therefore it is required that there will be much more spread than distribution(Lawless 1987).

3.2. Data

The data used in this study was obtained from Household Information Technologies Usage Research survey that was made by TUIK in 2014. Household Information Technologies Usage Research has been regularly carried out at annual period since 2004 (except for 2006) in accordance with EU regulations with the help of model questionnaire developed with the close cooperation of statistic offices of EU member countries of European Union Statistic Office and OECD. Every settlement place in Turkey was included in the scope for sample selection. Sampling method of the research is 2 stage layer cluster sampling method. At the first stage, the clusters (blocks) formed from average 100 households were selected for sample as contingent to in proportion to their bigness and at the second stage, sample address were determined by using systematic selection method among selected clusters for the sample. Methodology of the research covers individuals between the ages of 16 and 74 years old (TUIK).

3.3. MeasuresandVariables

In this study, dependent variable is number of the various information equipment that were present in the household. Various information equipment were determined as desktop computer (PC), portable computer (laptop, netbook, tablet, etc.), cell phones (including smartphones), landline phone, game console (PlayStation, Wifi, Xbox, etc.), digital camera/camcorder, a DVD / VCD / DivX player and internet connectable TV (Smart TV) at the survey of Household Information Technologies Usage Research. This variable takes whole number values between 0 and 8 for each household.Independent variables are access status of the household to internet, income level of the household and individual number of the household. The variables of access status to internet was stated under the categories of has access facility, has been used; has access facility, not used and has not access facility.Income level of the household was classified as 1stincome level, 2ndincome level, 3rdincome level, 4thincome level and 5thincome level. While 1stincome level indicated the worst income level, 5thincome level indicates the best income level. Turkey was divided into 12 regions at Level 1 under the name of Statistical Region Units Classification (SRUC).These regions and provinces taking place in these regions are shown at Table 1 in detail.

Table 1.Statistical Region Units Classification -Level 1

Kod	Level 1	Provinces
TR1	İstanbul	İstanbul
TR2	West Marmara	Tekirdağ, Edirne, Kırklareli, Balıkesir, Çanakkale
TR3	Aegean	İzmir, Aydın, Denizli, Muğla, Manisa, Afyonkarahisar, Kütahya, Uşak
TR4	East Marmara	Bursa, Eskişehir, Bilecik, Kocaeli, Sakarya, Düzce, Bolu, Yalova
TR5	Western Anatolia	Ankara, Konya, Karaman
TR6	Mediterranean	Antalya, Isparta, Burdur, Adana, Mersin, Hatay, Kahramanmaraş, Osmaniye
TR7	Central Anatolia	Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir, Kayseri, Sivas, Yozgat
TR8	West Blacksea	Zonguldak, Karabük, Bartın, Kastamonu, Çankırı, Sinop, Samsun, Tokat, Çorum, Amasya
TR9	East Blacksea	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane
TRA	NortheasternAnatolia	Erzurum, Erzincan, Bayburt, Ağrı, Kars, Iğdır, Ardahan
TRB	East Anatolia	Malatya, Elazığ, Bingöl, Tunceli, Van, Muş, Bitlis, Hakkâri
TRC	Southeastern Anatolia	Gaziantep, Adıyaman, Kilis, Şanlıurfa, Diyarbakır, Mardin, Batman, Şırnak, Siirt

Source: TUIK

Difficulty of establishing Development Agencies lies at the bottom of formation of SRUC regions in Turkey. As national program prepared following the participation association agreement concluded with EU deems SRUC regions as a precondition for establishment of Development Agencies, it necessitates establishment of SRUC regions. Current geographic regions were not taken into consideration at formation of SRUCs in Turkey and rather region borders were determined depending of different criteria. Foremost among them, population amount is primary. Except for population, cultural structure and development status of the provinces were taken into consideration (Taş 2006). The variable of number of the individuals in the household was classified as 1-2 persons, 3-4 persons, 5-6 persons and 7+. With the aim of looking effects of the categories belonging to all variables to be taken to poisson regression model, ordinal and nominal variables were defined as dummy variables.

4. Analysis

4.1. DescriptiveStatistics

Number and percentages of number of mean various information equipment per household and data used in the study according to independent variables are given at Table 2.

Table 2.Distribution of the individuals who participated to the study according to the variables

Variables	Frequency	Percentage
Status of internet access		
Has facility of access, has beenused	4892	50.1
Has facility of access, not used	656	6.7
Has nofacility of internet access	4215	43.2
Income		
1. incomelevel	2196	22.4
2. incomelevel	2022	20.6
3. incomelevel	1788	18.2
4. incomelevel	2056	20.9
5. incomelevel	1763	17.9
Regions		
TR1	1363	13.9
TR2	648	6.6
TR3	1184	12.1
TR4	970	9.9
TR5	965	9.8
TR6	1054	10.7
TR7	673	6.8
TR8	726	7.4
TR9	430	4.4
TRA	417	4.2
TRB	579	5.9
TRC	816	8.3
Individualnumber of thehousehold		
1-2 persons	2899	29.5
3-4 persons	4544	46.2
5-6 persons	1719	17.5
7 andupper	663	6.7
Number of theinformationequipment in thehousehold	Mean: 2.63 Std. Dev: 1.642	Variance: 2.696

*Total frequency of variables are different due to lost observation values.

It is seen at Table 2 that there is facility of internet access and internet is used at 50% of the households and 22.4% of the households are at lowest income group and 17.9% of the households are at highest income group. The most participation to the study was from TR1 (13.9%), TR3 (12.1%) and TR6 (10.7%) sub-regions, respectively. Individual number of the households at 29.5% of the households 1-2 persons, 3-4 persons at 46.2% of the households, 5-6 persons at 17.5% of the households and 7 persons and upper at 6.7% of the households.When Table 2 is examined, it is seen that there are mean 2.63 various information equipment per household. Mean and variance of household information equipment number is closed to each other. Main assumption of Poisson regression model was achieved. Frequency distribution of household information equipment number is given at Figure 1.

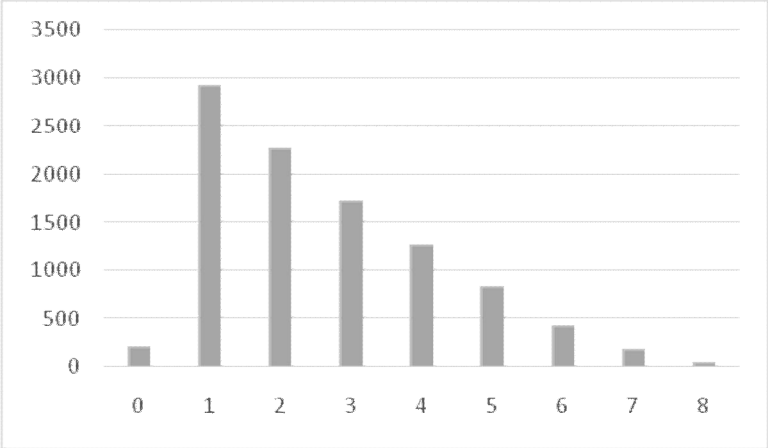

Figure 1. Distribution of number of informationequipment at thehouseholds

When Figure 1 is examined, it is seen that number of the households having one unit information equipment is the most one and number of the households having eight units information equipment is the least one.

4.2. Estimated Model

Poisson regression model was used with the aim of determining the factors that are effective at number of various information equipment available at the households. Ordinal and nominal variables were defined as dummy variables with the aim of observing effects of the categories belonging to all variables to be taken to Poisson regression model. It was tested that whether there was multiple linear correlation between independent variables to be taken to Poisson regression model. It is thought that the ones having 5 and upper variance inflation factor (VIF) leads to medium degree multiple linear correlation and the ones having 10 and upper variance inflation factor (VIF) leads to high degree multiple linear correlation (Bagheri, Habshah and Imon 2012). As seen at Table 3, any of the independent variables taken to the model has not 5 or more variance inflation factor. Accordingly, there is not any variable that leads to multiple linear correlation problem among the variables at the model.Poisson regression model to be established after independent variables to be taken to the model are determined is written as follows:

$$\text{Information E.} = \exp(Intercept + \beta_1 D_{facilityuseaccessused,i} + \beta_2 D_{facilityuseaccessnotused,i} + \beta_3 D_{2.incomelevel,i} + \beta_4 D_{3.incomelevel,i} + \beta_5 D_{4.incomelevel,i} + \beta_6 D_{5.incomelevel,i} + \beta_7 D_{TR1,i} + \beta_8 D_{TR2,i} + \beta_9 D_{TR3,i} + \beta_{10} D_{TR4,i} + \beta_{11} D_{TR5,i} + \beta_{12} D_{TR6,i} + \beta_{13} D_{TR7,i} + \beta_{14} D_{TR8,i} + \beta_{15} D_{TR9,i} + \beta_{16} D_{TRA,i} + \beta_{17} D_{TRB,i} + \beta_{18} D_{3-4persons,i} + \beta_{19} D_{5-6persons,i} + \beta_{20} D_{7personsandupper,i}) + \varepsilon_i$$

$$i = 1,2,3,\dots,9763$$

Marginal effects andresults of estimated poisson regression model is given at Table 3.

Table 3.Coefficient estimations and marginal effects of the factors that are determinant at the number of various information equipment

Variables	Coefficients	IRR	Std. Er.	P	95% CI		dy/dx	Vif
Status of internet access (Reference: Has nofacility of internet access)								
Has facility of accesss, has beenused	0.57	1.76	0.022	0.000*	1.720	1.806	1.495	1.51
Has facility of access, not used	0.19	1.21	0.027	0.000*	1.157	1.263	0.500	1.14
Income (Reference: 1. incomelevel)								
2. incomelevel	0.21	1.23	0.021	0.000*	1.190	1.271	0.546	1.62
3. incomelevel	0.33	1.39	0.024	0.000*	1.342	1.436	0.865	1.66
4. incomelevel	0.46	1.58	0.027	0.000*	1.526	1.632	1.203	1.87
5. incomelevel	0.65	1.91	0.033	0.000*	1.848	1.979	1.711	1.98
Regions (Reference: TRC)								
TR1	0.12	1.13	0.025	0.000*	1.083	1.179	0.323	2.59
TR2	0.14	1.15	0.028	0.000*	1.094	1.205	0.365	1.81
TR3	0.08	1.09	0.025	0.000*	1.041	1.138	0.223	2.40
TR4	0.12	1.12	0.026	0.000*	1.073	1.175	0.305	2.18
TR5	0.13	1.14	0.026	0.000*	1.085	1.188	0.335	2.16
TR6	0.04	1.04	0.024	0.093	0.994	1.088	0.102	2.20
TR7	0.08	1.08	0.028	0.003**	1.027	1.135	0.202	1.80
TR8	0.05	1.05	0.027	0.053***	0.999	1.104	0.130	1.87
TR9	0.05	1.05	0.030	0.111	0.990	1.107	0.120	1.52
TRA	0.06	1.06	0.031	0.048***	1.00	1.12	0.155	1.45
TRB	-0.01	0.99	0.027	0.635	0.93	1.04	-0.035	1.63
Individualnumber of thehousehold (Reference: 1-2 kişi)								
3-4 persons	0.06	1.06	0.006	0.000*	1.048	1.072	0.154	1.51
5-6 persons	0.03	1.03	0.005	0.000*	1.016	1.036	0.067	1.42
7 andupper	-0.01	0.99	0.006	0.177	0.981	1.004	-0.021	1.30
Constant	0.11			0.000				
Wald: 10374.35 Prob(Wald): 0.000	Pseudo R2: 0.1383 n = 9763							

*, ** and *** indicatesthesignificance at the0.1%, 1% and 5% levels, respectively.

It is seen that established model is statistically significant (P<0.000). The results gained at Poisson regression model is IRR (while all other variables are equal to their own averages, estimation ratio of that estimation of its own average of the relevant variables being 1 unit upper is equal to their own averages of all variables gives IRR. For example; while one unit increase at IRR value calculated for reel foreign exchange rate is equal to their own average of all variables, it leads to an increase on independent variable at the amount of 50% (Dişbudak and Türkcan 2005) or interpreted according to marginal effect values.According to poisson regression model, number of expected various information equipment at the households where there was facility of internet access and internet was used (IRR = 1.76, 95% C.I. = 1.72-1.81) and where there was facility of internet access but not used (IRR = 1.21, 95% C.I. = 1.16-1.26)was much more than the households where internet was not available.

In other words, number of expected various information equipment at the households where there was facility for internet access and internet was used and where there was facility for internet access but used was much more than the households where there was no internet, respectively 1.76 times (76%) and 1.21 (21%). Number of expected various information equipment at the households where annual income 2nd income level (IRR = 1.23, 95% C.I. = 1.19-1.27), annual income 3rdincome level (IRR = 1.39, 95% C.I. = 1.34-1.44), annual income 4thincome level (IRR = 1.58, 95% C.I. = 1.53-1.63) and annual income 5th income level was much more than the ones at 1st income level.

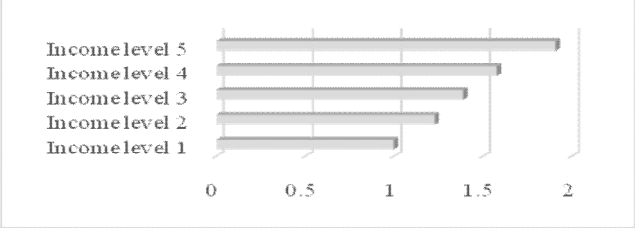

Figure 2. Effect of income level on number of expected information equipment at households

As seen at Figure 2, number of expected various information equipment increases as annual income level increases.Number of expected various information equipment in the houeholds available at the sub-regions of TR1 (IRR = 1.13, 95% C.I. = 1.08-1.18), TR2 (IRR = 1.15, 95% C.I. = 1.09-1.21), TR3 (IRR = 1.09, 95% C.I. = 1.04-1.14), TR4 (IRR = 1.12, 95% C.I. = 1.07-1.18), TR5 (IRR = 1,14, 95% G. A. = 1,09-1,19), TR7 (IRR = 1,08, 95% G. A. = 1,03-1,14), TR8 (IRR = 1.05, 95% G.I. = 1.0-1.1) and TRA (IRR = 1.08, 95% C.I. = 1.03-1.14) were much more than the households at TRC regions. In the similar way, number of expected various information equipment at the households where number of the individuals in the households was 3-4 persons IRR = 1.06, 95% C.I. = 1.05-1.07) and 5-6 persons (IRR = 1.03, 95% C.I. = 1.02-1.04) was much more than the ones where number of expected various information equipment was 1-2 persons.

The marginal effects stated at Table 3 gives average expected change at dependent variable against one unit change on independent variable. When it is thought in this way; while averages of other variables are constant, one unit change at the variable that had internet access facility and internet was used increased number of various information equipment in the dwelling 1.5 times. One unit change at the variables that had internet access but not used increased number of various information equipment in the dwelling 0.5 times.Income level was one of the important variables that was effective on number of the various information equipment available at the households. There was positive significant correlation between income level of the households and number of the various information equipment available at the households. As income level of the households increases, expected number of the various information equipment also increases. The households within highest income group increase expected number of various information equipment at the rate of averagely 1.7.

5. Discussion

Acceptance ratio of information technologies equipment such as telephone, mobile phone and computers has been on increase in the community and use of these has become widespread.Information technology products at increased number and various become indispensable aspects of our daily life.In this study, the factors that were effective on various information equipment at the households were carried out with poisson regression model by using cross-section data belonging to 9763 households in the Household Information Technologies Usage Research belonging to year of 2014 that was made by Turkey Statistical Institution.The highest participation to the study was from TR1 (Istanbul) region.Almost half of the households that took place in the study was formed from the households with 3-4 persons.The lowest participations was formed from the households that had 7 and upper individual number.Mean and variance values of the variable that was number of various information equipment available at the households were closed to each other and main assumption of poisson regression model was achieved.By taking annual income levels of the households into hand at five different level from lowest to the highest.According to poisson regression model results, majority of the variables taken to the model was significant.

It was detected that the case ofthat use of internet at the households having facility of internet access and having internet access facility at the households but not usedincreased expected number of various information equipment.As it is seen, it increased number of various information equipment at the households that internet and information was nested at the households (MacKay and Vogt 2012).Also regional differences affect use of information technology (Köksal and Anil 2015).In this study, it was detected number of various information equipment in other sub-regions were much more than provinces located in TRC (Gaziantep, Adıyaman, Kilis, Sanlıurfa, Diyarbakır, Mardin, Batman, Sırnak, Siirt) sub-regions. Compared to a household with two persons, it was detected that having 7 and upper individual in the household decreased number of various information equipment. Household size decreasestheusage of onlineactivities, but it does not matterforsocialnetworkingand online games(Köksal andAnil 2015).It was detected that income was one of the most effective variables on number of various information equipment. As income of the households increase, their expenditures also increases (Colak *et al.* 2008). We may say that this is also valid for information equipment (MacKay and Vogt 2012; Gupta and Kumar 2014).

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