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MOBILE TELEPHONY AS A CHANGE DRIVER IN RURAL AREAS

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Abstract

The aim of the paper is to reveal the most important causes of mobile telephony use by rural residents. In particular, the examination of the expected changes due to use of mobile phones and the assessment of the major causes that drive rural residents to desire mobile telephony access constitute the main objective of the paper. In addition, the study extends the employment of binomial econometric methodologies into rural development issues. Interesting results are revealed from the three discrete segments of rural populations regarding the drivers of mobile phone use. The majority of the users belong to the so-called “farmers”, where the dominant causes of mobile phone use are different from the rest ones. More specifically, causes such as region and number of young persons residing in the households were among the main reasons that compel them to obtain mobile telephony subscription and use.

Keywords: binomial logit model, change facilitation, mobile telephony, rural areas, survey

JEL: C01, D83, R11, R58

Introduction

Nowadays, the potential of rural areas to benefit for Information and Communication Technology (ICT) is a running question and one of the most salient subject matters of agricultural extension. Two main reasons have been identified as to why residents of rural areas adopt ICTs (Korsching, 2001; Sun and Wang, 2005; Akca et al., 2007): (a) ICTs can lead to improved productivity and (b) ICTs can reduce isolation and therefore can eliminate much of the misery of rural living and hardships of rural entrepreneurship. According to Malecki (2003), three main challenges are connected directly to the digital economy and the use of ICTs: (a) taping digital technology, (b) improving human capital and (c) sustaining the rural environment. Furthermore, in the face of these challenges and changes, rural areas look into the future and see both promise and peril. In particular, Mobile Telephony (MT) diminishes, and often entirely erases, the stickler of space and distance.

During the last decade the increase of the adoption of mobile phone (MP) in rural world is even more rapid. In particular, results from several European studies witnessed the rapid development of telecommunication in rural Europe such as in rural Greece (Moseley and Owen, 2008; European Commission, 2009). On the other hand, the majority of the studies about the diffusion of MP have been conducted in urban areas, and very few ones have been done in rural areas. However, due to the enormous urban–rural differences in social structure, life styles, and cultural values, it is expected that the diffusion process of new media technologies in rural area is distinct from that in urban one (Wei and Zhang, 2008).

Although the personal use of MP is very common scene in the developed countries such as in the major urban centres of the developing ones is not the case for rural areas and especially for older rural residents. However, the population of the developing countries is much higher than the developed ones. Thus, the use of mobile phones is probably a future subject of developing countries (Akpabio et al., 2007). Nowadays, almost 70 per cent of the world’s MP subscribers are in the developing world (E-agriculture, 2009). As an affordable and accessible means of communication, both men and women are realizing the potential of this technology to create economic opportunities and strengthen social networks in rural areas. The MT is no longer just an audio communication tool but capable of providing additional integrated functions.

Today, MT is being used to provide information to the farmers and rural residents through SMS and multimedia-supported systems in many countries. This has been made possible through both public and private sector initiatives. According to Wei and Zhang (2009) MT use offers real benefits to rural residents. In particular, connectivity to the outside world has been made so easy as well as unnecessary commuting to urban centres has been tremendously reduced. The whole benefits of MT use can be grouped in two general categories: (a) socio-economic and (b) rural. From a socio-economic point of view, MT effectively reduces the “distance” between individuals and institutions, making the sharing of information and knowledge easier and more effective. Social networks can be strengthened and individuals empowered through use of their handset. On the other hand, MT offers some unique rural opportunities. For example, MT providing a direct global communication channel

to rural communities, extending the impact of established rural media, making local content available and making rural services more efficient (logistics, coordination, etc) and cost-effective. These benefits are amplified by the fact that the spread of MT in some rural regions has occurred much faster than with other ICTs. Besides, in some countries, with high rural population densities, MT has quickly become much more cost-effective for telecommunication provision.

Nowadays, it is well documented that communication is closely linked to one's independence, well-being, and quality of life, especially in remote or rural areas. The contribution of this paper consists in the examination, for first time, of the effects of MT development in Greek rural areas. In particular, the main aim of this paper is to examine to what extent MT development relates with several significant desirable changes in three typical Greek rural areas. In addition, this paper explores the factors that influence patterns of MT subscription by the rural population of the study area and also try to reveal the most important causes of MT use by rural residents. Theoretically, the paper yields the straight-out result that MT development causes significant changes in rural areas. Practically, the paper illustrates how the theoretical findings can be translated into empirical actions and how MT works as a catalyst of change through the employment of a binomial logit model which estimates the change direction of the main MT subscription drivers. This paper initially describes the case study area. It then moves on to present the survey data and the model's details. Finally, results are discussed and policy implications are deduced.

Methodological background

Study area

Study area is comprised of three regions (Figure 1): West Macedonia (RWM), Central Macedonia (RCM) and East Macedonia-Thrace (REMT). The study area has been chosen due to the fact that it is a great representative figure of the whole Greece, in terms of internet use. Actually, according to the e-stats of NSSG (2010): (a) RCM is the most developed Greek region in terms of economic development (b) RWM belongs to the three less developed ones and (c) REMT expresses the mean values of all the thirteen Greek regions. Thus, Macedonia-Thrace or North Greece (NG) is a kind of Greek miniature and therefore results can be well generalized to the whole country.



Figure 1. Macedonia-Thrace

From a geographical point of view the three regions of NG hold together a central position in the general area of the Western Balkans as they represent the natural gate of Greece to the north borders

and especially to Albania, Bulgaria, Turkey and the Former Yugoslav Republic of Macedonia. The other Greek regions, which are adjoining the three Macedonian ones, are the region of Thessaly to the south and the region of Epirus to the West. The landscape of the regions mainly consists of highlands (47.8%), forest areas (22.3%), rangelands (33.4%) and cultivations or fallow lands (26.0%), and the majority of the regions' areas are rural. The NG regions include approximately 42,878 Km² or 32.6% of the total Greek land area.

Survey data

Data were collected through a mail-out/telephone response survey. All questionnaires were mailed out in batches of 30 per week from January to July 2007. Respondents were contacted by telephone in the following week and asked if they would like to participate. Respondents could either complete the forms in their own time and return them by post, or respond over the telephone. By July 2007, 920 responses had been received from 2,500 questionnaires issued giving an overall response rate of 36.8%. The survey was designed to monitor issues related to rural life and especially to MPs' effect on rural development. Questions in the survey were designed to elicit data on respondents' use of MT and their views on several prospective and desirable changes, following the literature. To encourage participation and minimise the cognitive burden on respondents, most questions were framed with *Likert* scale intervals.

From a technical-architectural point of view, the design process of the questionnaire is divided into two levels of functionality, as illustrated in Figure 2. These two levels consist of: (a) the section that provides information about personal or demographic characteristics of the respondents [tier-1] and (b) the section that provides information on household characteristics [tier-2], including the area section that fractions the research cases according to areas (Prefectures) [sub tier-2.1], average size (persons) [sub tier-2.2], income (median monthly) [sub tier-2.3], distance from urban areas [sub tier-2.4] and the use of MT [sub tier-2.5].

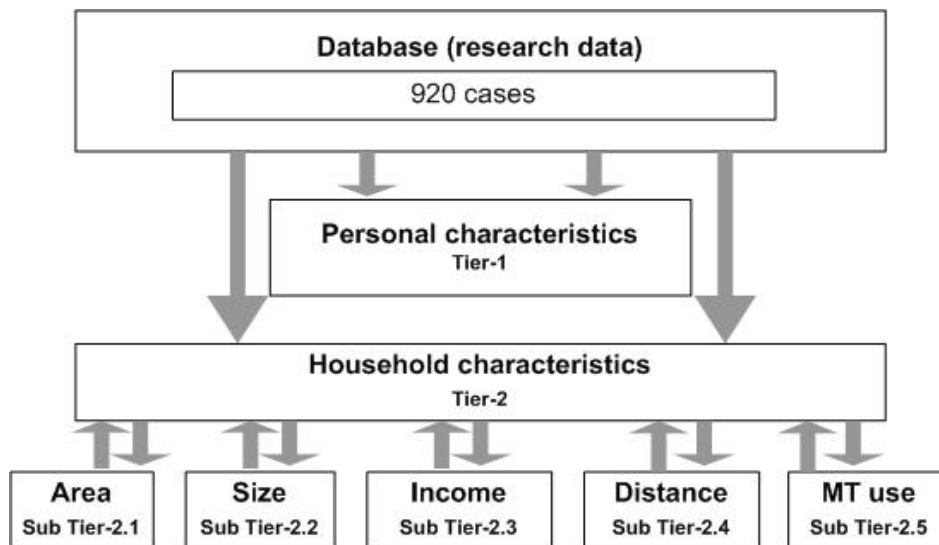


Figure 2. Database functionality

The model

The binomial logit model, first applied to the demand for higher education (Cramer, 1991) and afterwards to educational choices (Radner and Miller, 1970; Bishop, 1977; Jimenez and Salas-Velasco, 2000) can be seen as a special case of general model of utility maximization. Here it concerns those aspects of the economics of MT subscription choice that are regarded as important.

Assuming that a residents of rural areas can choose one of the two available options (1=MT subscription, 0=MT non-subscription), his/her (designated i) choice of the first option, implies that: $U_{i1} > U_{i0}$, where U_{i1} and U_{i0} are the utilities that i associates with a subscribing and non-subscribing decision, respectively. The utility U_{ij} that the alternative j gives to the individual i , is composed of two parts: a systematic term, which depends on an attributes vector X (stochastic ability, social

background, etc.) and a random one ε_{ij} : $U_{ij} = \overline{U}_{ij} + \varepsilon_{ij}$. But utility U_{ij} is not observable. What we observe is decision Y_i , which is worth 1 if the individual i choose to adopt and 0 if s/he chooses not to adopt. If a rational individual chooses the alternative that gives her/him the greatest utility, then: $Prob[Y_i = 1] = Prob[U_{i1} > U_{i0}]$ and $Prob[Y_i = 0] = Prob[U_{i0} > U_{i1}]$. McFadden (1974) proves that in this case the probability that rural resident i chooses alternative 1 is $Prob[Y_i = 1] = \frac{e^{X_i'\beta}}{1 + e^{X_i'\beta}}$

This would be the reduced form for the binomial logit model, where the X_i' row vector of explanatory variables for the i^{th} individual contains the independent or explanatory variables (including also a constant) and where we assume that the non-observed ε 's follow a distribution of logistic probability.

Results

The main research findings are presented in the four following sections: (a) sample summary statistics (Table 1), (b) profile of MT subscribers (Table 2), (c) benefits and limitations of MT use (Table 3) and (d) multivariate econometrics methodology (Table 4).

Table 1 summarises the basic characteristics of the sample. According to the statistical frequencies the representative participant of the study area is male, about 34 years old, married, with 11.5 years of education. Basic figures regarding his/her household indicate that the representative household is comprised of 2.7 persons while more than half (58.1%) of them are occupied in farming full time, gain a median monthly income of 1,048€ and 44.3% of their total household income come from farming. The average distance of the households from urban areas is 36.5 kilometres and mobile telephony use is found in almost 90% of the sample (87.07% of the NG households or 801 cases). The majority of the respondents is permanently occupied in the WCM (43.5%), 39.1% of them is permanently occupied in the RWM and the rest 17.4% of them is permanently occupied in the REMT.

Table 1. Description of the sample (920 cases)

| | |
|---|-------|
| Personal Characteristics | |
| Male (%) | 80.0 |
| Average age (years) | 34.0 |
| Average years of education | 11.5 |
| Married (%) | 55.4 |
| Household Characteristics | |
| Average size (persons) | 2.7 |
| Median monthly income (€) | 1,048 |
| Average total household income from farming | 44.3 |
| Farming full time (%) | 58.1 |
| Average distance from urban area (km) | 36.5 |
| MT use (%) | 87.1 |
| Area | |
| West Macedonia (%) | 39.1 |
| Central Macedonia (%) | 43.5 |
| East Macedonia-Thrace (%) | 17.4 |

Then, elaborating the answers, we found some interesting differences among the 920 respondents in terms of income (Table 2). Actually, residents of high income households (more than 25,000€) are more likely to have MT use than the ones of middle (12,501€-25,000€) and upper income (less than 12,500€) households, while no significant variation was found between residents of households near urban areas (less than 10km) and the rest ones (far away from urban areas) in terms of MT use. In fact income differences play a major role in explaining the variations of MT use among rural areas, more than the area itself, and lower levels of income are consistently shown to be associated with ICT inequalities (Verdegem and Verhose, 2009; Andre et al., 2010). What really matters in both rural and urban areas is income since Bell et al. (2004) show that middle and upper income people are more likely to use MT and ICTs than the rest ones.

Table 2. Profile of MT subscribers (920 cases)

| | |
|---|------|
| Income | |
| Less than €12,500 | 80.3 |
| €12,501-€25,000 | 91.2 |
| More than €25,001 | 98.4 |
| Location | |
| Near urban area (less than 10km) | 87.4 |
| Far away from urban area (more than 10km) | 86.9 |

According to Warren (2007) the relative advantages (potentials) of the technology use will be followed by absolute disadvantages (pitfalls). Towards this statement a paramount finding of this research is the user's norms over MT use as a positive or negative change driver. Table 3 presents 32 different probable causes (Moseley and Owen, 2008) of MT development or hysteresis. In particular 21 of them are rather positive (benefits) and they can be described as "potentials" and the rest ones are rather negative (limitations) and they can be described as "pitfalls". Respondents were asked to indicate their agreement or disagreement to the prospective causes, of the following Table 3, giving an internal value for each one of them.

Table 3. Potentials and pitfalls of MT use (920 cases)

| MT use benefits and limitations* | | Mean** |
|---|---|---------------|
| Pitfalls | High costs (1) | 4.3 |
| | Limited network coverage (2) | 4.1 |
| | Low bandwidth (3) | 4.0 |
| | Unfamiliarity (4) | 3.8 |
| | Limited capacity (5) | 3.7 |
| | Low awareness (5) | 3.7 |
| | Dangerous radiation (7) | 3.5 |
| | Dependency (8) | 2.4 |
| | Immoderately expectations (9) | 2.2 |
| | Over-information (10) | 2.1 |
| | Other negative effects (11) | 1.4 |
| Potentials | Capacity for communication (1) | 4.8 |
| | Ease of Use (2) | 4.6 |
| | Direct information (3) | 4.4 |
| | Psychological causes (4) | 4.3 |
| | Entertainment (4) | 4.3 |
| | Distance reduction (6) | 4.2 |
| | Time gain (7) | 4.0 |
| | Knowledge effectiveness (8) | 3.8 |
| | Social networking (9) | 3.6 |
| | Rural channels (10) | 3.5 |
| | Increased productivity (11) | 3.1 |
| | Home based rural business (12) | 2.8 |
| | Local content available (13) | 2.6 |
| | Rural services more efficient (14) | 2.4 |
| | Rural services cost-effective (14) | 2.4 |
| | Accessibility for illiterate users (16) | 2.2 |
| | Agricultural growth (17) | 1.8 |
| | Increased tourism (18) | 1.6 |
| | Government policies (19) | 1.5 |
| | e-education (20) | 1.3 |
| | Other positive effects (21) | 1.1 |

*Numbers in parentheses indicate the ranking sequence according to the mean values

**1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree

Mean values and changes ranking (Table 3) clearly demonstrate the potentials of MT development as there is a strong and positive relation between MT development and seven separate prospective and desirable benefits (mean value \geq 4.0): (a) capacity for communication, (b) ease of use, (c) direct information, (d) psychological causes, (e) entertainment, (f) distance reduction and (g) time gain. Moreover, respondents support that MT development rather enforces secondarily many other changes (mean value $<$ 4.0): easier and more effective sharing of information and knowledge, strength of social networks, direct global communication channel to rural communities, increased productivity, reinforcement of the home based rural business, making local content available, making rural services more efficient (logistics, coordination, etc) and cost-effective, providing accessibility for illiterate users (i.e. voice and images), supporting agricultural growth, increased tourism, supporting government policies, amplification of e-education and several other benefits. Increasingly, these benefits have been assessed in terms of diminishing the effects of distance from urban areas and core markets, which has long had a negative effect on the economic potential of rural areas. The above changes can also be considered in terms of the potential of rural areas exploiting the MT in order to enhance their learning capacity by improving their access to relevant information.

On the other hand, results also demonstrate the pitfalls of MT development in Greek rural areas according to the ranking of the limitations of MT. In particular, the main pitfalls of MT development are the following ones (mean value \geq 4.0): (a) high costs, (b) limited network coverage and (e) low bandwidth. Among the less significant MT limitations are (mean value $<$ 4.0): unfamiliarity, limited capacity, low awareness, dangerous radiation, dependency, immoderately expectations, over-information and few other causes for MT non-adoption.

Following, the multivariate econometrics model is employed to relate factors that influence patterns of MT subscription by the NG rural population. This is achieved by using MINITAB for Windows, release 14.1.3 (MINITAB, 2006). MT subscription is treated as a separate decision process and it is analyzed using a discrete choice model that relates the subscription probability to the factors of Table 4. In particular, a binomial logit model identifies the importance of determinants of NG MT subscription by sample strata (Madden and Coble-Neal, 2003).

More specifically, the dependant variable “subscription”, splits the sample in two subgroups: (a) MT subscribers (=1) and (b) MT non-subscribers (=0). The selection of the 15 independent explanatory variables of Table 4 was based on prior analysis of ICT networks while it is adapted to the research area particularities (Rappoport et al, 1998; Kridel et al, 1998; Madden et al, 1998; Madden et al, 2000; Madden and Coble-Neal, 2003).

Table 4. Model variables and description

| <i>Variable</i> | <i>Description</i> |
|-----------------|--|
| Price | Cost of MT subscribe and use (monthly estimations) |
| Region | 1=RCM, 0=otherwise |
| Sex | 1=male, 0=female |
| MT use | 1=frequent user, 0=sporadic user |
| Distance | Distance between respondent residence and the nearest urban centre (in km) |
| Income | Annual income |
| Education | Years of general education |
| Devices | Number of MT devices used |
| Persons | Number of persons residing in the households |
| Tertiary | 1=degree qualified, 0=otherwise |
| Training | 1=vocational qualification, 0=otherwise |
| Young residents | Number of residents aged under 18 years |
| Old residents | Number of residents aged over 65 years |
| Age | Respondent's age |
| Tone telephony | 1=existence of tone telephony, 0=otherwise |

According to the occupation of the household's principal, the sample has been stratified in three general groups of rural residents: (a) farmers, (b) entrepreneurs and (c) other cases. The majority of the MT subscribers are full time farmers (57.68%) while only 10.86% of them manage small enterprises and the rest ones are employees or occupied to several other vocations. Model results clearly demonstrate the importance of sample stratification as the drivers for MT subscription are significant different for these strata (Table 5). For example, the *farm model* suggests subscription is driven by "region" and "tone telephony" variables. In particular "region" demonstrates the subscription differences between RCM and the rest ones whereas "tone telephony" indicates the capacity to use alternative communication technology. On the other hand, in the *rural enterprise model*, the only significant driver is "devices" which most likely captures information and communication need. The explanation of MT subscription in the *household model* is more complex and related to "young residents", "distance" and "price" variables. The importance of presence of a resident under 18 years old for the household subscription implies the increased value of MT for young population. On the other hand, taken together increasing distance from the nearest urban area and the cost of MT use appear to swell local populations.

Table 5. Model estimates (801cases)

| Table 3. Model estimates (60 cases) | | |
|-------------------------------------|--------------|-------------|
| Variable | Coefficient | t-ratio |
| Farm model | | |
| Constant | -0.14 | -0.52 |
| Region | 1.47 | 1.89 |
| Distance | 0.11 | 0.42 |
| Tone telephony | 1.36 | 1.82 |
| Persons | 0.07 | 0.33 |
| Observations | 462 (57.68%) | |
| Rural enterprise model | | |
| Constant | -1.63 | -2.88 |
| Price | 0.11 | 0.29 |
| MT use | 0.07 | 0.22 |
| Employees | 0.06 | 0.17 |
| Devices | 0.88 | 2.68 |
| Observations | 87 (10.86%) | |
| Household model | | |
| Constant | -0.55 | -1.12 |
| Price | 0.94 | 1.96 |
| Distance | 0.97 | 1.84 |
| Young residents | 1.24 | 3.19 |
| Income | 0.12 | 0.88 |
| Observations | 252 (31.46%) | |

Conclusions

The present study has several important theoretical implications since its empirical results support the basic argument of the thesis that MT use covers significant needs of rural residents and therefore causes significant changes in rural areas. Basically, the results clearly demonstrate the importance of sample stratification into three discrete groups of rural residents as the drivers for MT subscription are entirely different among these groups. In particular, *farm model* results strongly indicate that increase in MT use has negatively influenced by the farming region and the existence or not of alternative communication capabilities. Besides, *household model* points out that the MT communication process of rural professionals has negatively influenced by the presence of a resident under 18 years old, the distance from an urban area and the cost of MT use. Moreover, *rural enterprise model* is much simpler and suggests that the MT communication process of individuals has negatively influenced just by the number of MT devices. Thus, the input of new policy measures, in order to encourage any desirable use of MT technology, should be specifically targeted towards these segments of the rural population, taking into account the specificities of each group.

On the other hand, rapid technology evolution such as the MT “explosion” facilitates access to urban and international markets and has been responsible for moderate to a high degree of rural systems changes. Above all, study areas have experienced noticeable improvements in the quality of life mainly due to rapid growth of capacity for communication. In addition, some supplemental reasons can be identified as to why residents of rural areas take up MT. First, MT use is extremely simple and can lead to direct information and therefore to further growth in agriculture or rural enterprises. Second, MT use causes several positive psychological effects as it makes rural population feel a kind of satisfaction while there is also a strong positive relation between MT uses to new recreation opportunities. Finally, MT use reduces the “distance” between rural and urban areas and therefore helps rural population to gain time. However, MT subscribers of the study area support that the cost of MT communication is still high enough, the network coverage is still limited and the bandwidth is not satisfied yet.

Concluding, with growing awareness of mobile telephony in rural areas, the forthcoming technology is expected to reduce costs of information access, to play a role in planning and setting up systems for rural development, to place greater emphasis on rural enterprise and to be used in a more systematic manner to share user-generated multimedia content describing indigenous knowledge.

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