Factors Affecting PC and Internet Usage by the Rural Population of Cyprus

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Abstract

It is widely accepted that the usage of the personal computer and the Internet can improve efficiency in the agricultural sector. Despite the fact that Information and Communication Technologies (ICTs) have evolved rapidly, the farmers are lagging behind in the use of ICTs. This study examines the factors that affect the usage of personal computers and the Internet by Cypriot farmers, by analyzing data from 526 farmers, selected by using the stratified random sampling method. Logit models are used to examine the socioeconomic characteristics of Cypriot farmers that may affect the usage or not, of the personal computer and the Internet. The results showed that 60.6% of them use the personal computer and 54.2% use the Internet. From the analysis of the logit models it was found that the age, the educational level, the income, the type of agricultural activities and the location of the farm, are significant determinants for the personal computer and the Internet usage. Future research is needed to examine the personal computer and Internet applications, their usefulness and the possible benefits for the Cypriot farmers from their usage.

Keywords: *ICT, PC and Internet usage, logit analysis, Cypriot farmers.*

1. Introduction

The use of Information and Communication Technologies (ICT) and especially of the Internet, can improve communication, increase participation, and help the dissemination and the exchange of skills and knowledge. ICTs create new services and business practices across many sectors of the economy. Transportation, professional services, and broadcasting are some examples of sectors that have been transformed by ICTs (Ramirez 2001).

Within the discourse of "Information Society", "Knowledge Society", "Information Economy" and the like, it is maintained that information and knowledge play a key role in ensuring sustainable development (Amponsah 1995; Koutsouris 2010). However, it is generally acknowledged that the rural population still faces problems accessing vital information that could help in making timely and accurate decisions (Anandaraja,

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Rathakrishnan & Philip 2006). Furthermore, Ferrer *et al*.(2003), report that in South Africa, as in other countries, the connection of rural areas to the Internet is still a problem, which means that the networking benefits of this technology, have not yet been implemented in the rural economies. Even where the Internet and ICTs are becoming widely accessible in rural areas, still there is a significant digital divide between rural and urban areas (Hall et al. 2003).

Personal computer (PC) and the Internet are considered to be of the most important technologies, and therefore this paper is focusing on them. Although the adoption of the PC is currently a requirement for using Internet, the two technologies are very different. Usually, the PC is used for the processing, manipulation and management of a farm's internal data and provides information for management decision making purposes. On the other hand, the Internet is used as a communication medium and allows a farmer to acquire and analyze external sources of information. Furthermore, the Internet provides farmers a convenient environment to communicate and make business transactions with buyers, consumers, suppliers, experts, and other farmers (Gloy & Akridge 2000; Ferrer, Schroder & Ortmann 2003).

Uncertainties brought about by global events and the evolution and complexity of the technology, greatly influence the agricultural sector. As a result, the need of farmers to access information, is also increasing (Amponsah 1995). Nowadays a growing number of farmers adopt and use the PC for farm managerial applications, as well as for market research and for obtaining marketing services. In the Computer Era the cost of obtaining, producing and delivering information has decreased, while the quantity and speed of information flow has increased. (Hall et al. 2003).

The Internet has been recognized as a tool that improves the efficiency and effectiveness in the agricultural sector. Potential uses of the Internet for farm businesses include: access to market prices and products' information, access to government and academic reports and research results, interaction with other farmers and agricultural specialists, purchase inputs, sell production, communicate with suppliers and buyers, and access to software applications (Gloy & Akridge 2000; Ferrer, Schroder & Ortmann 2003). Likewise, the Internet can be used as a tool to market their products to a much broader set of consumers (Mishra, Williams & Detre 2009).

ICTs enable farmers to overcome the geographical and other barriers to access information, to pursue education, to communicate effectively within the supply-chain, to promote and sell products directly to consumers, et cetera. The information transfer using the PC and the Internet, is enhancing the agricultural marketing strategy and increases the possibilities for more profitable farm businesses (Hall et al. 2003).

There is no doubt that rural development is a continuous challenge both in advanced industrial economies and less developed economies. Today, one important issue that the extension services have to deal with is how the Internet and ICTs can become beneficial to the rural areas (Michailidis et al. 2011). According to Rolfe, Gregor and Menzies (2003), in reality the ICTs and the Internet technology have been a "double-edged sword for rural areas". The reasons as to why the rural area population is taking up the Internet can be attributed to two main reasons. Firstly, the use of the Internet can improve productivity and therefore this may lead to further development of agriculture. The second reason, concerns the expectations of the residents in rural areas, related to the net benefits. These goals cannot be easily achieved and it is difficult to identify the

electronic transactions. In addition, many of the costs and benefits of using ICTs, cannot be associated with a market price. Non priced benefits may range from free products that are available on the Internet, to social benefits in remote areas, attributed to email access and social networking services. On the other hand, non priced costs include the additional time spent on solving problems related to harmful events, like data loss and virus infections (Rolfe, Gregor & Menzies 2003; Michailidis et al. 2011). Similarly, non priced costs incorporate the time spent for PC and Internet training.

During the past few years the use of the PC and the Internet has increased significantly by both households and enterprises. The Internet has become a core global communications technology for business, while firms that use it, have greater access to information and possibly a reduction of the costs associated with economic interactions (Smith et al. 2004). On the basis of the above, two questions may be asked: First, has the use of PC by farmers followed a similar trajectory and, secondly, has the Internet become an important source of information and a transaction mechanism?

The main aim of this paper is to examine the factors affecting the use of PC and the Internet by Cypriot farmers. Specifically, the key socioeconomic characteristics of Cypriot farmers, that may influence the usage or not of PC and the Internet, are examined. These characteristics include age, education level, income, type of agricultural activity and farm location.

Following the introductory part, the paper is organized as follows: in Section 2 the literature review is presented and in Section 3 the profile of the Cypriot agricultural economy is outlined through which the main goal of this study is documented. In Section 4, the research methodology is described, including the logit models. What follows is the presentation of the research results and the description of the PC and Internet models (Section 5). In Section 6 the findings are discussed. Finally, the conclusions and prospects for further research are presented in Section 7.

2. Literature Review

2.1 State of the Art

There is a growing literature related to the adoption and usage of ICTs in agriculture (Amponsah 1995; Baaijen & Pérez 1995; Thysen 2000; Warren 2002; Koutsouris 2010), and in rural and remote areas in general (Ramirez 2001; Madden & Coble-Neal 2003; Michailidis et al. 2011). PC and Internet usage in agriculture is a relatively recent phenomenon. Hence, reports in the international literature about the factors influencing the adoption and usage of the Internet by farmers are limited (Smith et al. 2004; Gloy & Akridge 2000).

The adoption and usage of the Internet and of PCs by Cypriot farmers has not been examined so far. In contrast, several studies on this subject have been conducted in other countries (Australia, United States of America, United Kingdom, Denmark, Greece, etc.). These studies have shown that PC adoption varies considerably depending on the rural population under study. Furthermore, these studies found that PC usage is influenced by the personal characteristics of the farmer (age, educational level) and the characteristics of the farm (e.g. farm size) (Putler & Zilberman 1988; Batte, Jones & Schnitkey 1990; Gloy & Akridge 2000).

2.2 European Union Countries

In the years 1996/1997 and 1999/2000 (repeat), the University of Plymouth in the United Kingdom conducted a study on a sample of 277 and 177 producers, respectively, to examine the use of ICTs (PC and Internet) in the agricultural sector. The survey has shown that the level of the PC and Internet adoption by farmers depends on the farm type and size, and the age and education of the farmers. Specifically, the study indicated that cattle and sheep farms, and smaller farms, are lagging far behind arable and larger ones. Furthermore, older farmers and those with no education beyond secondary school are more likely to be laggards than innovators. Finally, the study suggests that there is a "digital divide" which will create pockets of relative or even absolute disadvantage within rural society (Warren 2002). It should be noted that the "digital divide" between rural and urban areas exists in many countries. Even in Canada, the country with one of the most advanced ICT infrastructure, rural and remote communities lag far behind urban ones (Ramirez 2001).

Even though there is a plethora of papers related to the adoption of ICTs in agriculture in European countries, yet papers using econometric models to determine the factors affecting the usage of ICTs in agriculture are limited.

2.3 United States of America

Gloy & Akridge (2000) examined the factors affecting the PC and Internet adoption by large farms in the USA, as well as the reasons for which they use these two technologies. Using logistic regression models they found that the age and the educational level of the principal manager of the farm, are important factors for the adoption of both technologies. Furthermore, they found that the managers who use detailed management plans, are more likely to use the Internet. In contrast with to the Internet, farmers believe that, the PC can help them maximize their profits. The researchers found that farm size (total sales) is not a significant factor for Internet adoption, however it does influence the use of the PC. In general, Gloy & Akridge (2000) concluded that the personal characteristics of the farm managers are important factors for the Internet adoption, in contrast with the farm characteristics (total sales, farm type, et cetera), which were found not to be as important factors.

Amponsah (1995) studied the socioeconomic characteristics of commercial farmers in North Carolina, USA, that influence the usage and usefulness of the PC, and the use of professional services, such as those provided by tax preparers and extension services. Using multivariate logit models, he found that farm size, educational level and income, significantly influence PC adoption. Regarding farmers' perception of PC usefulness, he found to be significantly affected by farm size and educational level of the farmer.

Regarding the PC use in agriculture, Putler and Zilberman (1988), concluded that farm size, educational level and age, significantly influence the probability of PC usage. Similarly, Batte, Jones & Schnitkey (1990), found that age and educational level are determinant factors for PC adoption in agriculture.

Batte (2005) employed probit models to examine the factors affecting PC adoption by farmers, as well as its usefulness as a management tool. He found that increased farm size (gross annual sales) and higher educational level of the farmer, increase the likelihood of PC adoption. What is more, younger farmers were significantly more likely to adopt a PC. Adoption percent was found higher on farms that were more depended on

leased land, but it was found lower for livestock farmers. Likewise, off-farm employment was found to be an important factor for PC adoption, i.e. farmers who worked year-around away from the farm were more likely to adopt a PC. Concerning the usefulness of the PC, it was found to be affected by gross annual sales, by farmer's age and PC applications (records and information). Farmers that use the PC for keeping financial and production (crop or livestock) records or for gathering information from the Internet are more likely to evaluate the PC as a useful management tool than those who do not use these applications. To identify the factors influencing the hours of PC usage per month by farmers (only PC adopters), Batte (2005) employed a multiple regression model (Ordinary Least Squares-OLS). It was found that the size and the type of the farm significantly affect the hours of PC usage. An important finding of the study was that farmers who used the PC for the Internet-based information searches or online transactions reported significantly more hours of PC usage.

Hall *et al*. (2003) used the Diffusion-Adoption Model to classify 241 beef cattle and peanut producers into five adoption stages (non-adopters, late majority, early majority, early adopters, innovators) based on their current PC and Internet access and application of this technology to their farm. They concluded that almost 26% of the respondents had no PC access, over 50% reported having Internet access and nearly 40% used the Internet to find information related to their business.

Using multinomial logit models, Smith *et al*. (2004) found that farmers' age and farm size are significant determinants of PC and Internet adoption and usage patterns. In addition, they found that outside employment, college education and exposure to PC and the Internet through family and friends are more important, especially for the Internet, which is a newer technology than the PC. Moreover, they suggest that the perceived benefits of the Internet are mainly determined by how it is used and for how long the farmer has used it. Particularly, obtaining input pricing and agricultural commodity market information, enhances farmers' perceived competitiveness. The unique farm or farmer feature that significantly affects perceived benefits of using the Internet is whether or not the farm is classified as a family farm. It is noted that in the study of Smith *et al.* (2004) about half of the respondents who stated that they use the Internet for business, reported that they had no economic benefits from it.

Hoag *et al.* (1999) used logit analysis to examine the factors affecting PC adoption by Great Plains producers. Confirming previous studies, they concluded that factors including farm size (acres and sales), farm type (livestock farmers are less likely to adopt PC) and farming experience, significantly influence PC adoption. The major difference from other researchers is the fact that the educational level appears to have little or no impact on the PC adoption.

Unlike previous researchers who used multinomial logit model, Ascough *et al*. (2002) developed ordered logit model, which is an improvement of multinomial logit, in order to study farmers' satisfaction from using a PC, the frequency of PC use and the number of software applications used. The survey has shown that greater PC skill significantly increased farmers' satisfaction and the number of software applications used. Similarly, higher education increased user satisfaction and the number of software applications used but reduced frequency of PC use. In addition, the greater farming experience resulted in significantly increased user satisfaction but reduced frequency of PC use and number of software applications used.

Finally, Mishra & Park (2005) examined the key farm, operator, regional and household characteristics that affect the number of (different types of) Internet applications used by farm households. They found that the educational level of the farm operator, farm size, farm location and farm diversification, off-farm income and off-farm investments, as well as the presence of marketing contracts, have a significant impact on the number of Internet applications employed by farm operators.

2.4 Other Countries

Orbunde (2010) developed a binomial probit model to ascertain the relationship between the socioeconomic characteristics of farmers of the Middle belt region of Nigeria and the usefulness of their sources of agricultural marketing information. He found that educational level, income, household size, number of cities visited in search of useful sources of agricultural marketing information and location, all have positive and significant influence on useful sources of agricultural marketing information, while gender has negative and significant influence on useful sources of agricultural marketing information, indicating an inverse relationship with useful sources of agricultural marketing information among the participants. Furthermore, the research revealed that although farmers are exposed to ICTs (Internet), they are hardly aware of their use in marketing.
Rolfe, Gregor & Menzies (2003) attempted to determine whether the main benefits of PC usage and Internet access by grain and cattle producers of a particular region in Australia, are associated mainly with the reduction of costs or the increase in productivity. The farmers were asked to rate the value of PC and Internet use to their farm. Generally, the survey showed that producers consider the PC use and Internet access as important for their business. Using probit models they tried to predict the value of PC and Internet usage. In the first model, the "high value" of PC usage was significantly related to four variables (grain producers, computer linked equipment, accountancy packages and farm budgeting). In the second model, producers who rated the PC usage with "very high value" for their farm, were more likely to be cattle farmers, using PC linked equipment, have older PCs, value farm budgeting and word processing uses highly, and value Internet usage highly. The third model showed that cattle farmers, those with jobs off-farm, and those who want weather and market information, are more likely to put a low value on Internet use. The same model showed that farmers who access the Internet more frequently each week, those who rate e-mail highly, see that it provides more timely and better information for decision making, want less paperwork and a faster response time for ordering goods in, are more likely to put a high value on Internet use. Finally, the fourth model showed that producers with higher rates of access and those who put a high value on technical information, electronic banking, and social and recreational uses, are more likely to put a very high value on internet use. The probit models results indicated that the producers who value Internet use highly are those who wish to improve their efficiency.

Ferrer *et al*. (2003) used Ordinary Least Squares (OLS) regression analysis to identify the main factors influencing the use of Internet applications (e-mail, online banking and sourcing information from the World Wide Web) by commercial sugarcane farm businesses in South Africa. They found that the most significant factors affecting the number of Internet applications used by the farm for business purposes, is the period of time for which the farm has been connected to the Internet (the longer a farm business

has been connected to the Internet, the higher the number of Internet applications used), the educational level of the principal decision-maker (positive but statistically significant at only 12% level of probability), the time available to spend on the Internet and their perceptions of that as a source of information, and finally the characteristics of other farm PC users (in businesses where the children of the principal farm manager operates the farm PC, a greater number of Internet applications are used for business purposes). In contrast to other researchers, Ferrer *et al.* (2003) have found no discernible relationship between the age of the farm manager and the number of Internet applications used. Likewise, the study indicated no statistically significant relationship between off-farm employment and the number of Internet applications used. According to the authors, off-farm employment is likely to reduce farmers' time for using the Internet.

3. The Profile of the Cypriot Rural Economy

The Cypriot economy in general and as a consequence its rural economy, is in a transitional period, due to the new economic environment that was created, as a result of Cyprus' accession to the European Union (EU), in May 1st, 2004 (DOA 2010).

According to the Organization for Economic Cooperation and Development (OECD), rural areas are defined as the local units (e.g. municipalities) with a population density below 150 habitants per square kilometer. However, this definition is not used in the case of Cyprus, as it is a small island, with small agricultural land ownership and small to medium size cities. Therefore, in Cyprus, an area is characterized as rural, if it is not defined as urban[4] by the national cadastre. Consequently, the rural population of Cyprus is the population that lives permanently in rural areas, regardless the kind of employment. The farming population is not identical to the rural population but rather it is a subset of the rural population (DOA 2010).

Based on data provided by the Statistical Service of Cyprus (2009), the rural population of Cyprus is 29.8% of the total population. Since the beginning of the 20th century, the rural population of Cyprus accounted for the largest percentage of the total population. Particularly, in 1901, 81.2% of the total population was living in rural areas, while in 1960 that percentage dropped to 64%. Following the Turkish invasion in the island in 1974, the rural population was forcefully reduced and in 1982 was only 36.5% of the total population. From 2000 onwards, a small annual increase is observed and the percentage is now stabilized around 30%. This stabilization is attributed to the development of the infrastructure and of the road network, to the improvement of services in the rural areas, the creation of job opportunities in these areas, as well as to both the increased cost of living and the degradation of quality of life in the cities. (DOA 2010; Vakakis & Associates 2010).

However, the rural areas are also facing major problems and these are more significant and obvious in less favored, remote and mountainous areas. To start with, these areas have a low population density and unfavorable demographics. The population is relatively isolated, mainly due to the absence of direct connection with cities, limited public transportation and low quality of the rural road network. Furthermore, the rural population of Cyprus, as compared with the urban population, is lacking behind in edu-

[4] Urban Areas are those defined by the Local Town Plans

cation, present skewed age distribution and has lower incomes. Specifically, the level of education is lower than the national average, the majority of the residents are old people and the job opportunities are limited. In addition, the infrastructures for education and for healthcare provision are deficient. A serious weakness of rural areas is that a large proportion of the rural population is dependent heavily on agriculture, an activity that is shrinking. The dependence of the rural population on agriculture, due to the lack of alternative employment opportunities, is a barrier for the development of rural areas. Hence, there is a need for socioeconomic diversification and combination with complementary activities, such as rural tourism (agritourism). On the other hand, rural areas have significant advantages, like the natural resources and cultural heritage (DOA 2010; Planning Bureau 2006).

Despite the fact that the agricultural sector is shrinking, it is still considered as important in the Cyprus' economy and to rural population livelihood. Agriculture contributes merely 2.0% to the Gross Domestic Product (GDP), compared to 20.9% in 1965, 6.3% to employment and 21.3% to total exports (Statistical Service of Cyprus 2008). The most important Cypriot agricultural products are early potatoes, citrus fruit, olives, as well as vegetables and wine products. The most important animal products are meat (beef, pork, poultry and goat/sheep) and milk (cow and goat/sheep). As for processed Cypriot agricultural products (including traditional products), stable demand, both in the internal and third markers, is for: "haloumi", "lountza", "trahanas", "flaouna", "soutzoucos", "zivania" and local wines (DOA 2010).

The agricultural sector of Cyprus is facing several structural problems including the small size of holding and farm fragmentation, the aging and low educational level of the farming population, land degradation, water shortage, high production costs, limited agricultural research and marketing problems (Papadavid 2008; DOA 2010).

In relation to the adoption of ICT, there is a gap between rural and urban areas (Ramirez 2001; Madden & Coble-Neal 2003; Michailidis et al. 2011). The rural areas of Cyprus are not an exception. According to the Broadband Performance Index (BPI) of the European Commission, Cyprus is ranked second to last, before Bulgaria (European Commision 2008). Based on data by the Department of Agriculture (2010) there are 151 small and remote communities in Cyprus with no broadband access and are characterized as "white areas". Furthermore, ICT in agriculture is still very limited with the exception of certain intensive livestock units and food processing industries.

According to the Statistical Service of Cyprus (2011) 54.1% of farming households in Cyprus have access to a PC and 47.6% have access to the Internet. For urban households these percentages are 67.8% and 61.3%, respectively, showing the digital divide between urban and rural areas. The main reasons for not accessing the Internet are lack of skills and doubts about its necessity. On the other hand, the main reasons for using the Internet is searching for information for products and services, reading and downloading newspapers and magazines, and participating in social networks. The most common type of Internet access in rural households is broadband connection.

It is worth mentioning here that there are no research works dealing with the usage of PCs and the Internet in the Cypriot agriculture sector. Hence, it was considered that the factors affecting the use of PC and the Internet by Cypriot farmers need to be studied by field research and by using a structured questionnaire on a representative sample.

4. Methodology

To examine the usage of PC and Internet by Cypriot farmers, a stratified random sample of 949 producers was developed, covering all areas under the authority of the Republic of Cyprus[5]. The sampling frame was based on applicant-beneficiaries of the Rural Development Plan 2007-2013, and specifically on Measures 1.5.1 "Modernization of agricultural holdings" and 1.2 "Setting up of young farmers". Given that currently an official National Farmers' Registry is not available, based on our experience, we consider that the sample size selected is satisfactory. We followed the rules of the stratified random sampling method based both on crop and livestock production (two strata), and on location districts (five strata), as our main criteria for the categorization. Hence we consider that the results are reliable to the entire population where the sample was based.

The majority of the beneficiaries possess farms with fruits and vegetables, potatoes and cereals, whilst from the animal production farms most are breeders of sheep and goats, cattle and pigs. Between October 2010 and March 2011 we have visited 219 rural communities and with face to face interviews we collected 526 filled questionnaires[6]. This high response rate (55.4%) demonstrates the interest of the farmers towards this research topic. The response rate is higher compared to other studies [Batte, Jones, & Schnitkey, 1990 (40%); Amponsah, 1995 (31%); Hoag, Ascough II, & Frasier, 1999 (28%); Gloy & Akridge, 2000 (16.6%); Ascough II, Hoag, McMaster, & Frasier, 2002 (28.4%); Batte M.T., 2005 (50%)]. It must be noted that the above studies have not used the personal interview method.

In the present study, the non-respondents fall into three categories: those who rejected the interview (10.6%), those who did not show up to the interview (either due to illness or other personal reason) (26.7%), and those who did not answer the phone in order to make arrangements for an interview appointment (62.7%).

The aim of this paper is to identify the farm and farmer characteristics (gender, age, educational level, income, type of agricultural activity, location), that affect the PC and Internet usage. Because the usage or not is a binary choice (1=Yes, 0=No), logistic regression is suitable to predict the probability of usage as a function of several characteristics, hypothesized to influence usage (Gloy & Akridge 2000).

The key options for determining relationships (apart from non-parametric correlation techniques) are canonical correlation analysis, probit models, and logit models. Canonical correlation analysis is generally seen as a weaker (or last resort) statistical technique than probit or logit models. Logit model can be used by identifying the independent variables as categorical (Rolfe, Gregor & Menzies 2003). Ordinary regression analysis is not appropriate for investigating dichotomous or otherwise "limited" dependent variables, but linear probability, probit, and logit models are well-suited for such data (Aldrich & Forrest 1984).

Press and Wilson (1978) describe the results from logit analyses as being meaningful and appropriate whether the explanatory variables are multivariate normally distributed,

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[5] Since 1974, 36.2% of the total territory of the Republic of Cyprus is under illegal and continuing Turkish army occupation. As a result of the Turkish invasion, Cypriot agriculture has been severely affected.

[6] During the face to face interviews at least one of the researchers was present.

independent and dichotomous (zero-one), or multivariate normal and dichotomous. Thus, the robustness of the logit model coupled with its desirable statistical properties makes it appropriate for this analysis (Amponsah 1995).

Usage can be represented as a binary variable that is a function of a set of independent explanatory variables as has been done in previous studies (Batte, Jones & Schnitkey 1990; Amponsah 1995; Putler & Zilberman 1988). The logit model for computer and Internet usage is specified as follows (Batte, Jones & Schnitkey 1990; Amponsah 1995; Putler & Zilberman 1988):

$$Log\left[\frac{P}{1-P}\right] = a_0 + \sum a_i X_i + \varepsilon \quad (1)$$

where P is the probability of using a computer or Internet; $(1 - P)$ is the probability of not using; α's are the parameter estimates for the independent variables, X_i, that influence usage; and ε is the unexplained random component (Hoag, Ascough II & Frasier 1999).

PC and Internet usage are treated as separate decision processes. Usage is analyzed using a discrete choice model that relates the usage probability factors of Table 1. In particular, a binomial logit model identifies the importance of determinants of PC and Internet usage by sample strata (Madden & Coble-Neal 2003). This model, first applied to the demand for higher education (Cramer 1991) and afterwards to educational choices (Bishop 1977; Radner & Miller 1970; Jiménez & Salas-Velasco 2000), it can be seen as a special case of general model of utility maximization. Here it concerns those aspects of the PC and Internet usage that are regarded as important.

Assuming that a resident of a rural area can choose one of the two available options (1=PC Usage, 0=otherwise) and (1=Internet Usage, 0=otherwise), 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 the usage or not, 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 (social and economic background, etc.) and a random one εij: $U_{ij} = U_{ij} + \varepsilon_{ij}$.

But utility U_{ij} is not observable. What we observe is usage or not Y_i, which is worth 1 if the individual i is able to use PC and Internet and 0 if he/she isn't able to use. 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 $Prob[Y_i = 0] = Prob[U_{i0} > U_{i1}]$.

This would be the reduced form for the binomial logit model, where the $'i X$ 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 $\varepsilon's$ follow a distribution of logistic probability. More specifically, the dependent variable "usage", splits the sample in two subgroups: (a) able to use (=1) and (b) unable to use (=0) (Michailidis et al. 2011).

The selection of the 20 independent explanatory variables of Table 1 was based on prior analysis of ICT networks while it is adapted to the research area particularities (Kridel, Rappoport & Taylor 1999; Madden, Savage & Simpson 1998; Madden et al. 2000; Madden & Coble-Neal 2003).

Based on the above, in this paper we use logistic regression or logit models to determine the factors that affect the PC and Internet usage by Cypriot farmers.

5. Results

5.1. Descriptive Statistics

Using a structured questionnaire, the participants were asked to answer several questions related to the usage of PC and the Internet for business purposes. The results showed that 60.6% of the participants are using the PC and 54.2% are using the Internet on their own. A higher percentage 68.4% of the producers stated that they use the Internet either on their own or through others (children, spouse, friend, et cetera) for business purposes. The study suggests that farmers use the Internet to access agricultural related information, mainly about machinery and low cost inputs (67.3%), and for reading electronic newspapers and magazines (44.4%). It is worth mentioning that the overwhelming majority of the farmers, regardless of using the Internet or not, believe that the Internet is a useful information source (95%) and from those who use it (23.4%) state that they are "very satisfied" by its usage in the farm. Finally, they believe that the Internet can help them increase their productivity (51.7%), improve the quality of their products (60.6%) and reduce the production costs (73.8%), while 38.4% of the respondents believe that it can help them become innovative.

The statistical analysis for the survey was carried out by using the statistical package IBM SPSS Statistics version 20. In Table 1 the descriptive statistics of the selected determinants are presented. As shown, 88% of the participants are male. The age distribution shows that 7% of the farmers are between 18 and 28 years old, 23% are between 29 and 39 years old, 29% between 40 and 50 years old, and 25% are between 51 and 61 years old.

Regarding the educational level, 51% had completed secondary education and 22% tertiary education. In relation to income, 56% of the farmers belong to the low to small

Table 1: *Descriptive Statistics (N = 526)*

Variable	Description of variables	Mean	Standard Deviation	Observations
Gender	Dummy equals to 1 if the farmer is male and 0 if female	0,88	0,33	461
Age				
Between 18 and 28 years old	Dummy equals to 1 if the farmer is between 18 and 28 years old, 0 otherwise.	0,07	0,25	36
Between 29 and 39	Dummy equals to 1 if the farmer is between 29 and 39 years old, 0 otherwise.	0,23	0,42	120
Between 40 and 50	Dummy equals to 1 if the farmer is between 40 and 50 years old, 0 otherwise.	0,29	0,45	150
Between 51 and 61	Dummy equals to 1 if the farmer is between 51 and 61 years old, 0 otherwise.	0,25	0,44	134

Variable	Description of variables	Mean	Standard Deviation	Observations
Education level				
Completed secondary education	Dummy equals to 1 if the farmer has completed secondary education, 0 otherwise.	0,51	0,50	268
Completed tertiary education	Dummy equals to 1 if the farmer has completed tertiary education, 0 otherwise.	0,22	0,42	116
Income				
€5.000 to €20.000	Dummy equals to 1 if farmer's income is between €5.000 and €20.000, 0 otherwise.	0,56	0,44	295
€20.000 and above	Dummy equals to 1 if farmer's income is €20.000 and above, 0 otherwise.	0,37	0,38	195
Agricultural activity				
Crop farming	Dummy equals to 1 if the participant is a crop farmer, 0 otherwise.	0,65	0,48	342
Livestock farming	Dummy equals to 1 if the participant is a livestock farmer, 0 otherwise.	0,23	0,43	121
Employment type (full-time/part-time)	Dummy equals to 1 if the participant is a full-time farmer, 0 if is a part-time farmer.	0,64	0,48	337
Producers' Organizations	Dummy equals to 1 if the participant is a member of a Producers' Organization, 0 otherwise.	0,40	0,49	210
District				
Famagusta	Dummy equals to 1 if the farmer lives and works in Famagusta, 0 otherwise.	0,06	0,44	32
Larnaka	Dummy equals to 1 if the farmer lives and works in Larnaka, 0 otherwise.	0,20	0,43	105
Paphos	Dummy equals to 1 if the farmer lives and works in Paphos, 0 otherwise.	0,18	0,37	95
Limassol	Dummy equals to 1 if the farmer lives and works in Limassol, 0 otherwise.	0,28	0,44	147

Variable	Description of variables	Mean	Standard Deviation	Observations
Farm location				
Lowland	Dummy equals to 1 if the farm is in a lowland area, 0 otherwise.	0,41	0,49	216
Semi-mountainous	Dummy equals to 1 if the farm is in a semi-mountainous area, 0 otherwise.	0,33	0,47	174
Mountainous	Dummy equals to 1 if the farm is in a mountainous area, 0 otherwise.	0,25	0,44	132

and medium income groups (€5.000-€20.000) and 37% in the medium to high income groups (≥€20.000). As far as the farm activity is concerned, the majority of the farming population are engaged in crop production and 23% in livestock production. Regarding the employment type, 64% of the sample are full-time farmers and 36% are part-time. Another interesting result is that 40% of the farmers are members of Producers' Organizations. Moreover, farmers' location was found to be as follows: 28% live and work in Limassol district, 20% in Larnaka district, 18% in Paphos district and 6% in Famagusta. The small sample population from the district of Famagusta is attributed to the fact that the greater part of the district is under Turkish occupation. Further, 41% of the respondents live and work in lowland areas, 33% in semi-mountainous areas and 25% in mountainous areas (Table 1).

5.2. Chi-square (x^2) statistics

In Table 2 the chi-square statistics between the selected determinants and the usage of PC and the Internet are presented. If $p \leq 0.05$ then the independence hypothesis is rejected, and therefore the two variables are dependent. If $p > 0.05$ then the two variables are independent.

The hypothesis of independence for PC usage is rejected for gender, for two age groups (29 to 39 and 51 to 61 years old), for education level, for high income group (≥€20.000), for principle farm activity (crop farmer and livestock farmer) and for employment type. This implies that at the 5 percent level of significance (α=5%) the above mentioned explanatory variables are correlated with PC usage (dependent variable).

The hypothesis of independence for Internet usage is rejected for the age group 51-61, for the education level, for the principle farm activity when that is cropping, for the farm location when this is at semi-mountainous areas, for employment type and for income. This implies that at the 5 percent level of significance (α=5%) the above mentioned explanatory variables are correlated with the Internet usage (dependent variable).

5.3. Logit models

In the logit models the dependent variables are the *PC usage* and *Internet usage* by farmers on their own. The application of the logit models showed that, the majority of the estimated coefficients of the explanatory (independent) variables are statistically

significant at 1%, 5%, and 10% levels of significance, as illustrated in Table 3. Using the method of White, the estimated standard errors shown in parentheses are adjusted for heteroscedasticity.

Table 2: *Chi-square statistics (x^2)*

Variables	PC usage	Internet usage
	P-Value	**P-Value**
Gender	**0,015**	0,477
Age		
18 to 28 years	0,474	0,299
29 to 39 years	**0,045**	0,136
40 to 50 years	0,199	0,070
51 to 61 years	**0,000**	**0,000**
Education level		
Completed secondary education	**0,013**	**0,028**
Completed tertiary education	**0,016**	**0,000**
Income		
€5.000 to €20.000	0,751	**0,003**
€20.000 and above	**0,001**	**0,000**
Agricultural activity		
Crop farming	**0,004**	**0,001**
Livestock farming	**0,004**	0,477
Employment type (full-time/part-time)	**0,004**	**0,001**
Producers' Organizations	0,328	0,218
District		
Famagusta	0,300	0,667
Larnaka	0,168	0,612
Paphos	0,368	0,037
Limassol	0,092	0,595
Farm location		
Lowland	0,667	0,076
Semi-mountainous	0,569	**0,004**
Mountainous	0,494	0,341

Note: If $p \leq 0.05$ then the independence hypothesis is rejected, and therefore the two variables are dependent (**in bold**).

Table 3: *Logit models*

Variables	Logit model for PC usage	Logit model for Internet usage
	Coefficient (Standard Error)	**Coefficient (Standard Error)**
Gender	0.472*	0.048
	(0.272)	(0.313)
Age		
18 to 28 years	1.073**	0.785*
	(0.473)	(0.473)
29 to 39 years	1.103**	0.756**
	(0.375)	(0.348)
40 to 50 years	0.958***	0.720**
	(0.360)	(0.326)
51 to 61 years	-0.910**	-0.720**
	(0.365)	(0.319)
Education level		
Completed secondary education	1.477***	0.429***
	(0.248)	(0.248)
Completed tertiary education	1.626**	1.475***
	(0.313)	(0.314)
Income		
€5.000 to €20.000	-0.239*	-0.085
	(0.276)	(0.290)
€20.000 and above	0.351**	0.641**
	(0.303)	(0.325)
Agricultural activity		
Crop farming	-0.222*	-0.269
	(0.564)	(0.598)
Livestock farming	0.958***	0.836*
	(0.363)	(0.315)
Employment type (full-time/part-time)	-0.469**	-0.554**
	(0.222)	(0.246)
Producers' Organizations	0.703***	0.471
	(0.301)	(0.266)
District		
Famagusta	-0.524*	-0.386
	(0.384)	(0.392)
Larnaka	0.599*	0.602
	(0.395)	(0.399)
Paphos	-0.360*	-0.501
	(0.306)	(0.350)
Limassol	0.499	0.670
	(0.413)	(0.441)

Variables	Logit model for PC usage	Logit model for Internet usage
	Coefficient (Standard Error)	Coefficient (Standard Error)
Farm location		
Lowland	-0.326 (0.274)	-0.038 (0.282)
Semi-mountainous	0.031 (0.260)	0.081 (0.295)
Mountainous	-0.186 (0.287)	-0.264*** (0.303)
Constant	-1.095 (0.617)	-0.690*** (0.617)
Likelihood Ratio	-3,015.003	-3,888.099
R – Squared	0.20	0.21
Observations	526	526

* Indicates significance, at the 10% level;
** indicates significance at the 5% level;
*** indicates significance at the 1% level.

According to the results of the models, the *gender* has a positive and statistically significant influence at 1% level of significance on PC usage, with male farmers having a higher probability of using the PC compared to female farmers. The age of the farmers, as grouped, affects positively and significantly both PC usage and Internet usage, except that of the group *51 to 61*, which signifies that, the farmers in this age group are less likely to use PC and Internet. Particularly, the age groups *18 to 28* and *29 to 39* have a positive and statistically significant effect at 5% level of significance on PC usage. Similarly, the age group *40 to 50* years old has a positive and statistically significant effect on PC usage, at 1% level of significance As far as the Internet usage is concerned, the first three age category groups have a positive effect that is statistically significant at 5% and 10% level of significance. The age group *51 to 61* is having a negative and statistically significant effect on the usage of both technologies at 5% level of significance.

As expected, the education level has a positive and statistically significant effect in all cases. *Completed secondary education* has a positive and statistically significant effect on PC and the Internet usage at 1% level of significance. The coefficient of the variable "*completed tertiary education*" is positive and statistically significant for PC and Internet usage at 5% and 1% levels of significance, respectively.

In the case of income, low and medium income groups (*€5.000 to €20.000*) have a negative sign and thus a negative relation with the PC and Internet usage, but only in the case of PC usage this negative effect is statistically significant (10% level of significance). The farmers belonging to the high income groups (*≥€20.000*), as these are reflected in the next category, appear to be quite familiar with both PC and Internet usage. Specifically, the coefficient of the variable "*≥€20.000*" is positive and statistically significant at 5% level of significance, in both models.

The coefficient of the variable "*crop farming*" has a negative sign in both models, however only in the case of PC it is statistically significant (at 10% level of significance). On the other hand, the variable "*livestock farming*" has a positive and statistically significant influence on the use of both technologies, at 1% and 10% levels of significance.

The *employment type* has a negative and statistically significant effect on PC and Internet usage at 5% level of significance. On the other hand, farmers' participation in *Producers' Organization* has a positive effect on both technologies, but only in the case of PC usage is statistically significant (at 1% level of significance).

Regarding the district where the farmers live and work, the coefficient of the variable "*Famagusta*" has a negative sign in both models. However, only in the PC usage model it is statistically significant at 10% level of significance. The district "*Larnaka*" has a positive effect on the usage of both technologies, but only in the PC usage is statistically significant at 10% level of significance. In addition, the district "*Paphos*" has a negative influence on both technologies, but it is statistically significant only in the PC usage model, at 10% level of significance. The coefficient of the variable "*Limassol*" has a positive sign in both models however none of them is statistically significant.

Finally, regarding the location of the farm, the variable "*lowland*" has a negative, but not significant effect on the usage of both technologies, while the variable "*semi-mountainous*" has a positive, but not significant effect on the usage of both PC and Internet. The coefficient of the variable "*mountainous*" has a negative sign in both models, but it is statistically significant only in the Internet usage model at 1% level of significance.

6. Discussion

Summarizing, from the results of the logit models, it appears that gender, age and education level of the principle farm owner, the annual income, the farm type (crop or livestock farming), the employment type (full-time or part-time), the participation in a Producers' Organization and the district, are factors that significantly influence the usage of PCs by farmers. About the usage of the Internet, it appears that it is significantly affected by the age and the education level of the farmer, the income level, the farm type (livestock farming) and the farm location, as well as from the employment type. In general, younger and more educated farmers, mainly livestock producers, with high income, who are employed part-time in agriculture, have a greater probability of using ICTs (PC and Internet).

It seems that as long as the education level increases, the stronger is the relationship between farmers and the PC and Internet usage. Educated farmers, particularly those who have fulfilled tertiary education are more exposed to new technologies and by extension they adopt and use them in their farms. This should be expected, given that the use of PC and the Internet is deemed necessary for graduating from tertiary education. Yet, many farmers acknowledge the importance of new technologies and express interest to learn how to use PCs and the Internet. This could be accomplished through the delivery of special education courses to farmers by public and private institutions, even by courses organized by Producers Organizations.

It appears that there is reverse relationship between the age and the usage of PC and the Internet. That is, as the age increases the usage of the PC and the Internet decreases. Younger generation farmers are more inclined to using new technologies, while older generation farmers do not use them for various reasons. Many of the old farmers state that they do not have the skills to use PCs, but others, mainly small farmers, believe that the cost of using these technologies is high. Many farmers claim that PC and Internet usage cannot help them in any way to increase their income and in general to accomplish their goals.

Crop farmers, in relation to livestock farmers are less likely to use the PC and the Internet. In contrast, livestock farmers appear to be particularly familiar with the PC and the Internet. Many of them, mainly cattle farmers, maintain modern and intensive units, in which they have modern systems, such as automatic feeder and automatic milking system, for the management of which they use PCs.

Part-time farmers are more likely to use the PC and the Internet than full-time farmers. This may be due to the fact that part-time farmers are more exposed to new technologies than full-time farmers, which usually work all day in the fields and therefore do not have the time to deal with the PC and the Internet. According to Warren (2002) staring at a PC screen is not an attractive proposition after a long and hard day's work outside. Batte (2005) suggests that farmers are often introduced to new technologies by off-farm employment and subsequently use them.

The participation of the farmer in a Producers' Organization increases the probability of using PCs. In several cases, Producers' Organizations drive their members to use new technologies, while the producers who participate in an organization influence each other in relation to the use of new technologies. Baaijen & Pérez (1995) indicate that low-resource smallholders can have access to new technologies only through local farmer organizations, especially with state support or external funding. This suggests that small farmers may not have enough money to adopt and use new technologies by themselves.

Of particular interest is the relationship between the district of activity and the usage of the PC and the Internet. Producers that live and work in the districts of Famagusta and Paphos are less likely to use PC and Internet in relation to the farmers that live and work in the districts of Larnaka and Limassol. This may be due to the fact that the districts of Famagusta and Paphos are smaller, both in size and population, as compared to the districts of Larnaka and Limassol, and therefore fewer farmers live there and consequently there are fewer opportunities for interaction.

Finally, in relation to the location of the farm, the farmers that live and work in lowland and mountainous areas have smaller probability to use PC and Internet from those who live and work in semi-mountainous areas. The producers of the mountainous and remote areas are less exposed to new technologies. In addition, young people of those areas move to the cities seeking a better future, so that the majority of those remaining behind are older farmers. It is surprising that the producers of lowland areas, who live near the cities, are less likely to use PC and the Internet. It may further be due to complacence of producers of lowland areas, who usually cultivate larger areas, so they do not search for ways to increase their income.

Most of the results of this study were as expected, with the farm and farmer characteristics significantly influencing the usage of the PC and the Internet. Several research-

ers have found similar results (Putler & Zilberman 1988; Batte, Jones & Schnitkey 1990; Amponsah 1995; Hoag, Ascough II & Frasier 1999; Gloy & Akridge 2000; Batte 2005). However, none of them has studied whether the participation of the farmers in Producers' Organization affect the use of the PC and the Internet. This study has found that the participation in a Producers' Organization has a positive and statistically significant influence to the usage of the PC. Regarding the Internet usage, it was found that the influence of the participation in a Producers' Organization is positive, but not statistically significant.

7. Conclusion

This paper examines the factors that determine the usage of two related technologies, the PC and the Internet, by Cypriot farmers. The originality of the study lies in three pillars: a) we use countrywide farm-level data comprised of different farm types and farm locations, b) it is the first study of its kind that examines the usage of PC and the Internet in Cypriot agriculture, and c) it is among very few studies where the questionnaires were collected with face to face interviews, which increases the reliability of the sample.

The percentage of farm producers who use the PC and the Internet for agricultural purposes (60.6% and 54.2%, respectively), is quite high. From the analysis of the structure of non-respondents, one may suspect some upward bias in these figures, as older people more often avoid participation in research interviews, so that the attributes of younger people influence the overall picture.

Logit models were used to determine the factors that influence the usage of the PC and the Internet. Consistent with previous studies, the age of the farmer and the education level affect significantly the usage of the two technologies. Younger and more educated farmers are more likely to use the PC and the Internet, compared to older and less educated farmers.

The Producers' Organizations could play a significant role in the adoption of these new technologies by farmers. The Department of Agriculture of Cyprus, is promoting with various ways the organization of farmers and especially through the Rural Development Program 2007-2013. It is believed that through the organizations, farmers interact and influence each other. Hence, when there are success stories because of PC and Internet usage by some farmers, others are more likely to follow and adopt these technologies.

The fact that producers with high income are more likely to use PC and the Internet, may imply that smallholder farmers with low income may choose not to use these technologies due to the cost associated with their adoption. Consequently, the government could introduce some measures as incentives to those who invest in purchasing and using these two technologies in their farm business.

Given that this study is the first of its kind that deals with the usage of PC and the Internet by Cypriot farmers, further research is needed, with regard to the usage of these two technologies and other ICTs, like mobile phones, as well as to concentrate on smallholder and less educated farmers. Furthermore, future research should study the PC and Internet applications that are used by Cypriot farmers, their usefulness, and the gains that may result for the farmers and for the rural economy of Cyprus in general.

References

Aldrich, J & Forrest, N 1984, *Linear probability, logit and probit models. Sage University Paper Series on Quantitative Applications in the Social Sciences.*, Sage Publications, Beverly Hills.

Amponsah, W 1995, 'Computer Adoption and Use of Information Services by North Carolina Commercial Farmers', *Journal of Agricultural and Applied Economics*, vol. 27, pp. 565-576.

Anandaraja, N, Rathakrishnan, T & Philip, H 2006, 'Dissemination of Agricultural Technologies through Interactive Multimedia Compact Disc (IMCD): An innovative Approach.', *Computers in Agriculture and Natural Resources*.

Ascough II, JC, Hoag, DL, McMaster, GS & Frasier, WM 2002, 'Computers in Agriculture. Computer Use and Satisfaction by Great Plains Producers: Ordered Logit Model Analysis', *Agronomy Journal*, vol. 94, pp. 1263-1269.

Baaijen, M & Pérez, E 1995, 'Information technology in the Costa Rican dairy sector: A key instrument in extension and on-farm research', *Agriculture and Human Values*, vol. 12, no. 2, pp. 45-51.

Batte, MT 2005, 'Changing computer use in agriculture: evidence from Ohio.', *Computers and Electronics in Agriculture.*, no. 47, pp. 1-13.

Batte, MT, Jones, E & Schnitkey, GD 1990, 'Computer Use by Ohio Commercial Farmers', *American Journal of Agricultural Economics*, vol. 72, no. 4, pp. 935-945.

Bishop, J 1977, 'The effects of public policies on the demand for higher education', *Journal of Human Resources*, vol. 12, no. 3, pp. 285-307.

Cramer, JS 1991, *The LOGIT model: An introduction for economists*, E. Arnold (London and New York and New York, NY)

DOA 2010, *Rural Development Programme for Cyprus 2007-2013. With vision and perspective for the Cypriot farmer.*, ed.^eds 4th, Ministry of Agriculture, Natural Resources and Environment, (in Greek), p. 268.

European Commision 2008, *Future networks and the internet. Indexing Broadband Performance*, p. 16.

Ferrer, SR, Schroder, DH & Ortmann, GF 2003, 'Internet use and factors affecting adoption of the internet applications by sugarcane farm businesses in the Kwazulunatal-Midlands', *41st Annual Conference of the Agricultural Economics Association of South Africa (AEASA)*.

Gloy, B & Akridge, J 2000, 'Computer and internet adoption on large U.S. farms', *International Food and Agribussiness Management Review*, vol. 3, pp. 323-338.

Hall, L, Dunkelberger, J, Ferreira, W, Prevatt, JWa & Martin, N 2003, 'Diffusion-adoption of personal computers and the internet in farm business decisions: Southeastern beef and peanut farmers.', *Journal of Extension*, vol. 41, no. 3.

Hoag, DL, Ascough II, JC & Frasier, WM 1999, 'Farm Computer Adoption in the Great Plains', *Journal of Agricultural and Applied Economics*, vol. 31, pp. 57-67.

Jiménez, JdD & Salas-Velasco, M 2000, 'Modeling educational choices. A binomial logit model applied to the demand for Higher Education', *Higher Education*, vol. 40, no. 3, pp. 293-311.

Koutsouris, A 2010, 'The emergence of the intra-rural digital divide: A critical review of the adoption of ICTs in rural areas and the farming community.', in *9th European IFSA Symposium, 4-7 July*, Vienna, pp. 23-32.

Kridel, D, Rappoport, P & Taylor, L 1999, 'An econometric study of the demand for access to the Internet', in *The future of the telecommunications industry. Forecasting and demand analysis*, ed. DLL Taylor, USA: Kluwer Academic Publishers.

Madden, G & Coble-Neal, G 2003, 'Internet use in rural and remote Western Australia', *Telecommunication Policy*, vol. 27, pp. 253-266.

Madden, G, Savage, S, Coble-Neal, G & Bloxham, P 2000, 'Advanced communications policy and adoption in rural Western Australia', *Telecommunication Policy*, vol. 24, pp. 291-313.

Madden, G, Savage, S & Simpson, M 1998, 'Asia-Pacific telecommunications USOs: Current practice and future options', *Prometheus*, vol. 16, pp. 485-498.

Michailidis, A, Partallidou, M, Nastis, SA, Papadaki-Klavdianou, A & Charatsari, C. 2011, 'Who goes online? Evidence of internet use patterns from rural Greece.', *Telecommunication Policy*, vol. 35, no. 4, pp. 333-343.

Mishra, AK & Park, TA 2005, 'An Empirical Analysis of Internet Use by U.S. Farmers', *Agricultural and Resource Economics Review*, vol. 34, pp. 253-264.

Mishra, AK, Williams, RR & Detre, JD 2009, *Internet Access and Internet Purchasing Patterns of Farm Households*.

Orbunde, AK 2010, 'Communication as an effective tool in Agricultural Marketing Information System (AMIS) dissemination: Implications for the future', in *9th European IFSA Symposium, 4-7 July*, Vienna, pp. 343-349.

Papadavid, G 2008, *Review of agricultural economics and agricultural trade integration into the wider European market (in Greek)*, Agricultural Research Institute, p. 38.

Planning Bureau 2006, *Strategic Development Plan 2007-2013*, Republic of Cyprus, Nicosia (in Greek).

Press, J & Wilson, S 1978, 'Choosing Between Logistic Regressino and Discriminant Analysis', *Journal of the American Statistical Association*, vol. 73, no. 364, pp. 699-705.

Putler, DS & Zilberman, D 1988, 'Computer Use in Agriculture: Evidence from Tulare County, California', *American Journal of Agricultural Economics*, vol. 70, pp. 790-802.

Radner, RR & Miller, LS 1970, 'Demand and Supply in US Higher Education: A progress report', *The American Economic Review*, vol. 60, no. 2, pp. 326-334.

Ramirez, R 2001, 'A model for rural and remote information and communication technologies: a Canadian exlporation', *Telecommunication Policy*, vol. 25, pp. 315-330.

Rolfe, J, Gregor, S & Menzies, D 2003, 'Reasons why farmers in Australia adopt the Internet.', *Electronic Commerce Research and Applications.*, no. 2, pp. 27-41.

Smith, A, Morrison Paul, Goe, WR & Kenney, M 2004, 'Computer and Internet Use by Great Plains Farmers, California', *Journal of Agricultural and Resource Economics*, vol. 29, no. 3, pp. 481-500.

Statistical Service of Cyprus 2008, 'Agricultural Statistics ', vol. II, no. 40, p. 153.

Statistical Service of Cyprus 2009, *Demographic Report 2009. Population Statistics II*, No. 47, (in Greek).

Statistical Service of Cyprus 2011, *Information and Communication Technologies (ICT) usage in households and by individuals, 2004-2011. Key figures*, Republic of Cyprus, Nicosia.

Thysen, I 2000, 'Agriculture in the Information Society', *Journal of Agricultural Engineering Research*, vol. 76, pp. 297-303.

Vakakis & Associates 2010, *The effects of accession in the EU and the future and dynamic of the Cypriot agricultural sector* Department of Agriculture. Ministry of Agriculture, Natural Resources and Environment, (in Greek).

Warren, MF 2002, 'Adoption of ICT in agricultural management in the United Kingdom: the intra-rural digital divide', *Agricultural Economics*, vol. 48, pp. 1-8.