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The moderator effect of training in the adoption of ICT in microenterprises

El efecto moderador de la formación en la adopción de las TICs en las microempresas

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Abstract:

This research aims to study two determinant factors of the ICT adoption and use in the Spanish micro-enterprise's framework. Furthermore, this article analyses the combined influence of the age and the training experience of the entrepreneur according to the use of ICT in the company. Previous research has considered that the age of the entrepreneur has a negative effect while the level of education of the entrepreneur always have a positive effect in the use of ICT. However, any previous research has found the analysis of the combined effects of both variables together: the age and training, since the combined effects may be different from the effects of each variable separately. On this basis it has analysed a sample of 148 Spanish firms with fewer than 10 employees. The survey results seem to conclude that the specific training of entrepreneurs on issues related to ICT, (rather than the overall level of their training), moderates the negative effect caused by the increasing age the employer in the use of ICT.

Keywords:

ICT adoption, ICT_Knowledge, age, training, education, microenterprise.

Resumen:

Este trabajo pretende estudiar dos de los factores determinantes de la adopción y uso de las TIC en las microempresas españolas. En particular, este artículo analiza la influencia combinada de la edad y la formación

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del microempresario en el uso de las TIC en la empresa. Los estudios tradicionales consideran que la edad tiene un efecto negativo en el uso de las TIC, mientras que el nivel de formación del empresario favorece y promueve el uso de las mismas. Sin embargo, no se han encontrado investigaciones en las que se hayan analizado los efectos combinados de la edad y la formación, por lo que el presente estudio pretende comprobar si los efectos conjuntos de ambas variables son distintos a los efectos de cada variable por separado. En base a esto se ha realizado un análisis a una muestra de 148 empresas españolas con menos de 10 empleados. Los resultados del estudio parecen concluir que la formación específica de los microempresarios en cuestiones relacionadas con la tecnología de la información y la comunicación, y no tanto el nivel general de su formación, es lo que modera el efecto negativo producido por el incremento de la edad del empresario en el uso de las TIC.

Palabras clave:

Adopción de las TIC, conocimiento de las TIC, edad, formación, educación, microempresa.

1. INTRODUCTION

Information and communication technologies (ICT) can be considered one of the strategic factors in helping to improve business processes and change the role of markets (Pollard and Hayne 1998; Feeny 2001; Taylor and Murphy 2004; García Fernández y Cordero Borjas 2008; Papastathopoulos and Beneki 2010). For this purpose, the use and management of technologies and, specifically, information and communication technologies (ICT) are critical (Farbey et al. 1994; Pollard and Hayne 1998).

Despite these considerations concerning ICT, its use and adoption varies according to company size. Levy and Powell (2005) and others like Zabala (2012) argue that small and medium enterprises (SME) have still not understood the real importance of ICT and the technology applied to the innovation in their business model. These works are linked to a research line that studies the differences in motivations, strategies and performance between large and small businesses. This research line has an even greater importance given the representation of small and medium enterprises (and in particular microenterprises) specifically in Europe. This research focuses on microenterprises (enterprises with fewer than 10 employees).

Given this context, firms need to make more efficient use of available resources and manage innovation as a vehicle to achieve competitive advantage. The increase of efficiency derived the use of ICT is one of the main topics analyzed by literature. In fact, ICT facilitates the innovation process by automating repetitive tasks. That is one of the reasons why unskilled workers are dispensed with and replaced by technology (Francanlanci and Galal 1998; Autor et al. 2003), producing a positive impact on firms' efficiency. The reduction of management positions and unqualified employees, while maintaining production, allows firms to be more efficient (Francanlanci and Galal 1998; Autor et al. 2000), maintaining employees more motivated (Caroli and Van Reenen 2001; Bresnahan et al. 2001) and improving information and decision flows (Gera and Gu 2004).

This efficiency gained by inclusion of ICT usually produces changes on the structure of the company and employees behavior. In this sense, there is some consensus in the literature on the relationship between the inclusion of ICT by businesses and their degree of perceived utility. The use and management of ICT has proved decisive in the organizational architecture of firms during the last few decades (Farbey et al. 1994; Pollard and Hayne 1998), becoming one of the cornerstones of the business strategies of companies (Papastathopoulos and Beneki 2010). So, managers should focus in the correct implementation of ICT, based on the comprehension and acceptance of the players.

According with the previous opening, it is necessary to point out the importance to understand the main factors which determine the ICT adoption. Some of the principles features analyzed by literature (Bekman et al. 1998; Yuen et al. 1999; Acemoglu 2002) and considered as the determining factors of ICT adoptions are: confidence in the use of ICT, attitudes of the users of ICT; the development of skills and positive attitudes towards their use are considered to be essential for their integration, acceptance and use.

In the case of the small companies focused on in this article, the role of managers has been looked at by several studies, in which different features were related to the personal and intellectual growth of the entrepreneur and the results of the company (Bosma et al. 2004; Vivarelli 2004; Colombo and Grilli 2005; Martínez-Román y Romero 2013). One of

the conclusions of these studies is that the behaviour of small business is often similar to that of the manager. In fact, some characteristics of the entrepreneur such as: their training, their age or gender could affect the decisions making in the company (Benito Hernández et al. 2012). In the Spanish case, according to the GEM report (2011), 41.7 percent of entrepreneurs have secondary education studies, and only 27.8 percent have higher education, with the average age of micro entrepreneurs in Spain being thirty-eight.

So according with the previous arguments and to conclude this introduction, this research tries to study, on the one hand, how specific training of entrepreneurs moderates the dual effect of age on the use of ICT, and on the other hand, what type of microenterprise training is most conducive to the use of ICT in small firms.

The structure of the paper is organized as follows: Section two reviews some of the major theoretical and empirical data to date dealing with the topic of the determinants of adoption and use of ICT by microenterprises. In particular this review focuses on the effect of age and microenterprise training, leading to the formulation of the hypotheses that will then be contrasted in the future. The third section is devoted to the methodology followed in order to contrast the hypotheses, describing the sample and data sources, and then how to treat the variables used in the analysis. The fourth section discusses the results obtained from the analysis of the data described in the preceding section. Section five presents the main conclusions and recommendations.

2. THEORETICAL AND EMPIRICAL BACKGROUND

2.1. Models TAM and SBTC

Traditionally, two of the most accepted theoretical models that have attempted to explain the adoption of ICT by enterprises have been TAM and SBTC. These models focus on the factors affecting the adoption of ICT.

According with these models, the acceptance and appropriate use of information technologies depend, in part, on: the levels of confidence in their use and attitudes of the users; the development of skills and positive attitudes towards their use are considered to be essential for their integration, acceptance and use (Yuen et al. 1999). In line with this idea, a generally accepted model is the Technology Acceptance Model (TAM) (Davis 1989; Davis et al. 1989). This model is a valid approach for understanding the acceptance of computer applications in general. Specifically, the TAM model suggests the existence of a direct positive effect between the attitude toward the use of ICT, the intended use and actual use.

Another model that could support this work is the Skill-Biased Technical Change (SBTC) that argues that there is a relationship between the level of employee skills and technological advances incorporated into the company, in particular the development of ICT. Furthermore, the SBTC's literature suggests a positive correlation between higher levels of formal education and cognitive abilities (Bekman et al. 1998; Acemoglu 2002). This is what is known as skill-biased technical change (SBTC) (Griliches 1969). According to this model, technological change increases the demand for skilled workers. In a knowledge economy, technological change leads to organizational innovation because information technologies (IT) reduces both information processing and improves the internal commu-

nication in the firms (Garicano and Rossi-Hansberg 2006), creating flatter organizational structures, typical of small businesses.

One cause of this lesser use and value of ICT in small businesses is their dependence on cost-effectiveness (Chacko and Harris 2005). However, other studies indicate that one of the major differences that justify the use of ICT in small businesses, as opposed to large ones large, comes from an internal variable, linked to the entrepreneur / manager (Vossen 1998; Burke 2010). Some studies have contrasted that small businesses tend to be more successful in industries where greater weight is given to skills and abilities (Acs and Audretsch 1990). Other works argue that the strengths of small businesses do not reside in resources but features such as flexibility, entrepreneurial culture and motivation of both employees and the owner (Vossen 1998).

In order to understand the research proposal of this paper is necessary to emphasize why age and training are considered as two of the most important factors in the adoption of ICT by businesses and in particular by the micro. Here are some arguments in the literature review that justifies this choice.

2.2. The age of the entrepreneur and the use of ICT

In the small business, the owner and the manager are usually the same person (Burke 2010), performing multiple tasks of organization, taking the majority of strategic decisions in addition to controlling all the resources at their disposal. For this reason, and because of the horizontal structure which small businesses often have, the owner is decisive in decision-making and the implementation of strategic measures (DeLone 1988; Yap et al. 1992; Windrum and Berranger 2002).

Often, owners of small businesses have little or no ICT training and lack knowledge of the benefits that ICT can offer their business (GEM Report 2011). The result is a major obstacle to the adoption of ICT (Barba-Sanchez et al. 2007). However, this does not justify the failure of numerous studies to demonstrate that the age or the training of micro entrepreneurs are often more influential factors than the size of the business sector and understanding of the use of ICT, in the implementation of ICT processes in businesses (Blackburn and McClure 1998).

Empirical research conducted by Palvia and Palvia (1999) and Chapman et al. (2000), have found that the owner's age is a factor that can determine the successful adoption of ICT by small businesses (Ford et al. 1996), as the ageing of employees or owners sometimes poses serious problems with regard to the adoption of ICT by businesses, particularly small ones. Several earlier studies have focused on the study of the moderating effect of age on technological change. Different perspectives suggest that older workers do not adapt well to changing technology. A first explanation for this is that cognitive skills are lost with age (for example, see Touron et al. 2004), as are the skills to acquire new technical skills (see Czara et al. 1989; Korupp and Szydlík 2005). Moreover, the willingness and ability of older workers may impede technological change and innovation. Older workers show more resistance to change and adaptability to new technologies (Aubert et al. 2006), so it follows greater adaptability to technological changes occur companies with younger staff. Therefore, and as discussed above, the SBTC and TAM suggest that simultaneity in

the adoption of technological and organizational innovations has a significant impact on company performance.

The knowledge and skills are insufficient when you consider the constant change and continuous updating that ICT users face. In this sense, technological innovations are a push factor that often leads to older workers opting out of using these kinds of technologies. Moreover, increasing age affects the behavior of individuals when competing and cooperating, and consequently the process of adoption and use of ICT (Shih-Yung and Pearson 2011). In this sense, they can perceive a negative relationship between innovative attitude and intention of use of ICT due to the loss of technological skills and the lack of adaptation to change, and the age of the entrepreneur (Aubert et al. 2006).

It is important to consider the relationship between the use and adaptation of ICT and the experience. In this sense other studies have analyzed the number of years the company has been in the industry, as a motivating factor in the use of ICT. There are several studies suggesting that firms with more experience in the market are able to adapt, implement and carry out strategic actions relating to the use and management of ICT more efficiently than other companies with little experience (Franz and Robey 1986; Sorensen and Stuart 2000). Younger firms are disadvantaged in the process of adaptation and application of new ICTs (Sorensen and Stuart 2000). Other authors, however, have found that younger firms are more likely to develop the process, implementation and use of ICT (Goode and Stevens 2000; Balasubramanian and Lee 2008). This could be because older firms have entrenched structures, where domination and legitimation exercise a role as barriers to effective implementation of ICT in these companies (Chatterjee et al. 2002).

Some studies point out that more than age; it is previous business experience in ICT that should be one of the factors to take into account in explaining the use and results of ICT in small and medium enterprises (Papastathopoulos and Beneki 2010). Burke et al. (2002) and Westhead et al. (2005) argue that entrepreneurs with management experience are more likely to start businesses, and grow faster than those without it. Therefore, they expect a positive relationship between attitude and intention of use of ICT and the age the owner and/or experience of the company.

2.3. The educational-training level of the micro entrepreneur and the use of ICT

Moreover, another feature of the profile of the micro entrepreneur that can bring about a greater or lesser use of ICT is the educational-training possessed. The relationship between education, training, ICT and business performance has always been an important subject of study by the scientific literature (Storey 1994; Roper 1999; Hausman 2005; Levenburg et al. 2006).

Due to frequent shortages of workers with up-to-date technical skills, firms have to pay (Forth and Mason 2006). Since large corporations can afford this overpayment more easily than small firms, for small firms training is a more convenient mechanism for developing technical skills. In this sense, training enables employees to access a range of new knowledge and skills, highlighting new ways of operating to innovate (De Saá-Pérez et al. 2012). Training will also serve as a trigger for the generation of new products, processes and technologies as a result (Roffe 1999; Shipton et al. 2005). Another reason in favor of

training in small firms is that it implies lower organizational complexity, since it can be easily outsourced (Galanaki et al. 2008). For these reasons, developing technical training will have a positive impact on small firms' efficiency.

According to various studies on organizational behavior and management of technology and information systems, there is empirical evidence showing that attitude, when it comes to adopting and using ICT is related to the perception of its use (Davis 1989; Mathieson 1991; Taylor and Todd 1995). Thus, education and training of individuals is a determining factor in the adoption and use of ICT, as they have a positive effect on perceived usefulness (Lee Sang et al. 2010). In this regard, Holt and Crocker (2000), showed how negative past experiences in the use of ICT can affect the individual's motivation to optimize performance, opposing the use of ICT, thus showing that education and training of individuals is needed to moderate this perception, and motivate the use of ICT. For these reasons, they can perceive a positive relationship between attitude and intention of use of ICT and the level of training and studies of the entrepreneur.

Batte (2005) suggests that the use of ICT in a business will be influenced by the education of its users. Likewise, Chibelushi and Costello (2009) suggest that the education of individuals is one of the determining factors in the speed of adoption of ICT in business. Therefore, ICT training is needed in business management in order to be able to adapt to change and optimize the results of its use. However, it must differentiate between general training or education (university degree, compulsory education ... etc.) and specific training (ICT expert courses, similar programs or specific studies on particular technologies). Studies such as Fulantelli and Allegra (2003) suggest the key to increased use of ICT by small businesses is specific or continuous training on ICT-related issues. Other works such as Admiraal and Lockhorst (2009) studied the formation of companies in relation to ICT and e-learning. This paper aims to study more in depth the separate effect that both types of training can have on the use of ICTs by small firms.

Sometimes the obligatory introduction of ICT in the company is usually the main reason for failure of the ICT strategy in business. Lack of education and expertise can contribute to the lower rate of adoption of ICT by businesses (Kogilah et al. 2008). Therefore, educating and training managers and employees by creating a corporate awareness of the benefits that ICT has, is the foundation of successful integration and use of ICT (Barba-Sanchez et al. 2007).

This paper tries to analyze whether the attitude towards the use and therefore the intended use of ICT in microenterprises, is influenced by the age or training of the entrepreneur. This influence plays a key role in the technology integration process of microenterprises, according to the arguments cited above. These studies show the importance of support from the ownership / management to facilitate the successful adoption of ICT (Palvia and Palvia 1999; Koellinger 2008).

3. MODEL AND HYPOTHESES

From the exposure of the theoretical models and the literature review of the previous section it could conclude that age, training and know how-are linked by the role of the owner (Burke 2010). In line with this idea, some research have studied certain relationships

between the age of the owner (Shih-Yung and Pearson 2011) and the age of the company (Goode and Stevens 2000; Sorensen and Stuart 2000; Chatterjee et al. 2002; Balasubramanian and Lee 2008) and the use of ICT. From these studies a negative relationship between the age of the entrepreneur is found (Aubert et al. 2006; Shih-Yung and Pearson 2011) and the use of ICT and, conversely, a positive relationship between their experience in the market and its use (Franz and Robey 1986; Sorensen and Stuart 2000; Burke et al. 2002; Westhead et al. 2005; Papastathopoulos and Beneki 2010). Finally, another factor influencing positively the use of ICT is, as noted above, training (Fulantelli and Allegra 2003; Admiraal and Lockhorst 2009; Lee Sang et al. 2010).

This work contributes to this line of research by proposing a model with interactions. This model intends to complete previous research, by studying the joint effect of age and training on the use and adaptation of ICT in business. Given the ambiguity of previous works regarding the positive and negative relationships on the use of ICT it is interesting to provide more results that will analyze what the net effect of these factors together can produce. Specifically, this work tries to analyze whether the training of the entrepreneur can moderate the negative effect of age on the use of ICT.

In this sense, the effects on the use of ICT would have two components: firstly, it would have a negative effect called “conservatism” caused by age, loss of skills and capabilities, and the aversion to change produced by it. On the other hand, there is a positive effect of increased knowledge and training in ICT by the entrepreneur. The end result of both effects on the use of ICT depends on the net effect of these two components, which has traditionally been considered negative, as the component of “conservative” risk aversion associated with the use of ICT had been assumed as the predominant factor.

With this background, this paper proposes as a priority objective to emphasize the fact that age may play a dual role, exerting a positive or negative influence on the use of ICT, depending on the use of moderator variables, such as general or specific training. In other words, this study seeks to determine whether the traditional consideration by the scientific literature of the negative influence of the age of microenterprise on the use of ICT by companies (Warr 1993; Ford et al. 1996; Palvia and Palvia 1999; Chapman et al. 2000; Borghans and Weel 2002; Rouvinen 2002; Aubert et al. 2006; De Koning and Gelderblom 2006; Schleife 2006; Shih-Yung and Pearson 2011), can become positive if combined with the general or specific training of the entrepreneur.

Several studies explain how age favors the loss of cognitive technological skills and so does not help to promote the use of ICT. There is, therefore, a negative relationship between them, which some studies consider can be significant (Tao et al. 2009). However, the question is whether entrepreneurs who have studied and been trained in generic and / or specific areas (the two cases will be looked at) moderate the negative effect of age on the use of ICT.

Other studies, on the other hand, show how access to ICTs by older entrepreneurs, can lead to cost savings in search of business opportunities, which can favour the process of innovation and competitive advantages. In this sense, Colin (2006) explains how age need not be an impediment to the adoption of advanced technologies for example, or technological innovations, because in the current environment there are many systems and tools. The micro entrepreneur’s training and education in the technology ecosystem of our day can help us to understand how crucial the optimum use of ICT may be (Barba-Sanchez et al.

2007), leading to the improved perception of its usefulness in business management (Lee Sang et al. 2010).

For all these reasons, this paper hopes to provide some contributions, by proposing the following hypotheses for discussion:

Hypothesis 1: The education level of micro entrepreneur moderates the negative effect of age on the adoption of ICT.

Hypothesis 2: Prior knowledge of ICT by the micro entrepreneur moderates the negative effect of age on the adoption of ICT.

4. METHODOLOGY

4.1. Sample and data

This work focuses on small companies, specifically on microenterprises, which are defined as those with fewer than 10 employees, in accordance with Recommendation 2003/361/EC of the European Commission on May 6, 2003.

The final sample of 148 companies can be considered representative in aspects such as the sector (Table 1) and the gender of the entrepreneur. The sample size is in line with previous studies using data from small companies (by way of example, the work of Hadjimanolis(2000) has a sample size of 140 small and medium enterprises [SMEs], and for the Spanish case De Saa et al. (2011), a sample of 139 SMEs was used). The method of selection of the companies in the sample was random, chosen by shares according to sector of activity size of the total workforce and geographic regions.

Table 1

Business distribution by sector

Sector	Spanish Enterprises Population (%) (2009)	Sample of 148 enterprises (%) (2009)
Services	34,7	33,7
Distribution	25	27,6
Industry	11,81	10
Real State	11,31	9,3
Transportation	7,08	8,7
Hospitality	10,1	10,7
Total	100	100

Source: Own elaboration.

The surveys were carried out face to face and by telephone. Phone numbers and other contact details were obtained using the database “System Iberian Balance Analysis” (SABI)⁴ and the field period goes from December 2009 to June 2010.

Table 2 describes the study data sheet. As shown in the description of the companies under study, the distribution of the sample in terms of gender, age and studies of the micro entrepreneurs, as well as the age of the firm are similar to results obtained by the GEM⁵ report (2011), and can therefore be considered as representative in this regard.

Table 2

Technical details of the study

Population	
Sampling units	Micro
Population of microenterprises	3.128.181
Type of population	Infinite
Elements of sampling	Micro entrepreneurs surveyed
Scope	National
Time	December 2009 - June 2010
Sample	
Choice of companies	Random
Sample size	490
Type of survey	Face to face and telephone
Number of calls issued	927
Surveys received	148
Response Rate	37%
Description of the companies under study¹:	
Gender micro entrepreneur	78 per cent are male.
Studies of the small businessman.	53 percent have higher education, either college or advanced vocational training.
Permanence of the company in the market.	95 percent have more than 5 years in the market.

Source: Own elaboration.

Based on the review of the literature on the characteristics and management of microenterprises, a questionnaire was developed. This questionnaire was sent to the manager or officer of the company, and consisted of twenty closed questions collecting data on internal factors such as: equity, number of employees, age, education, membership networks, promoted corporative social responsibility (CSR) activities and other questions related to the proposals raised in the work. The information regarding other complementary factors

⁴ Database distributed by Bureau van Dijk Electronic Publishing, which contains financial information obtained from the annual accounts of over 900.000 Spanish and Portuguese companies.

⁵ The Global Entrepreneurship Monitor (GEM) project is an annual assessment of the entrepreneurial activity, aspirations and attitudes of individuals across a wide range of countries. Initiated in 1999 as a partnership between the London Business School and Babson College, the first study covered 10 countries; since then more than 85 ‘National Teams’ from every corner of the globe have participated in the project, which continues to grow annually.

has been obtained from SABI. With this information, the variables were constructed as described below.

In this study the dependent variable is the use of ICT for management. Therefore, this variable was constructed with information obtained from the questionnaire, which takes the value one if the microenterprise used technologies for management, and value zero otherwise. The dependent variable “use of technologies in management” refers to the use of ICT in the microenterprise and is specified through the use of websites and e-mail by the microenterprises surveyed.

The independent variables correspond to the theoretical model, which includes the determinants of micro entrepreneur profile, such as, age of the owner, age of the firm and training, as well as interactions between the variables under study, with the control variables introduced in Table 3:

Table 3
Definition of variables

Type of Variable	Aspect under study	Factor being assessed	Definition	Source	Values
Dependent	Use of Technologies for management	Use of Technologies for management	Use of Technologies for management, including ICT	Survey	0=No 1=Yes
Independents	Profile of micro entrepreneur	Age	micro entrepreneur age	Survey	Discrete (years)
		Regulated studies and trainings	Level of education		1=No education 2=Primary education 3=Secondary education 4=High school 5= Professional training 6=Higher education 7=Masters & postgraduate studies
	Experience	Age of the firm in the industry	SABI	Discrete (years)	
	Control variables	Financial	Share Capital social	Survey/ SABI	Continuous (thousands of €)
		Scope of activity	Activities of the company	Survey	1=local 2=Provincial 3=Regional 4=National 5=International
	Interactions	Age_Studies			
ICT_Knowledge					

Source: Own elaboration.

Finally, two control variables have been added to the analysis to reduce the omitted variable bias. The first refers to the scope of the company. Companies whose activities are carried out in sprawling geographic areas, such as national and multinational companies, may tend to use more ICT due to the fact that geographic dispersion leads to greater organizational complexity, which in turn increases the adoption of ICT (Sandulli et al. 2010). Studies like that by Liu and Ravichandran (2008), indicate that geographic diversification, especially in the service industry, reinforce ICT investment. This may be due to the communication needs and efficiency in management, necessary for managing customers, suppliers and employees in different locations. In addition, other studies such as Chari et al. (2008) observed that companies need relatively high levels of ICT investment to improve financial performance (Tobin's q) of international diversification.

The second control variable considered in the analysis is self-financing. Companies with more self-financing are more likely to use ICT. Some research such as those by Aguiar et al. (2002) state that the most innovative companies and those taking higher risks in the implementation of new technologies, should establish a system of funding, through forms such as venture capital. But no studies have been found on whether self-financing for microenterprises, given their specific characteristics, can have a positive effect of making the use of ICT more likely. However, one would expect companies with higher equity to have less need for debt and less problems with credit and financing. For this reason, it is expected that independent companies, from a financial point of view, are more likely to use ICT.

4.2. Results and discussion

The analysis results are presented in Table 4.

Tabla 4

Results

Dependent variable: USE_ICT Method: ML - Binary Probit (Quadratic hill climbing) QML (Huber/White) standard errors & covariance		
Variable	Coefficient (standard error)	Coefficient (standard error)
Constant	-3.618618** (1.207579)	-1.367403 (1.836070)
EXPERIENCE	0.045789* (0.023904)	0.039616* (0.023292)
ICT_KNOWLEDGE	1.725697*** (0.313104)	-1.548478 (1.257277)
EDUCATION	0.351454** (0.168287)	0.418380 (0.441905)
EQUITY (x1000)	0.000674** (0.000331)	0.000775* (0.000378)

AGE	-0.003674** (0.001745)	0.082078 (0.060387)
GEO_DISPERSION	-0.100321 (0.131682)	-0.129518 (0.133561)
AGE x EDUCATION		-0.000426 (0.013228)
AGE x ICT_KNOWLEDGE		0.105245** (0.040149)
R2 de McFadden	0.326761	0.363148
Log likelihood	-44.77600	-42.35595
AIC	0.976906	0.968980

* $p < 0.01$; ** $p < 0.05$; *** $p < 0.001$

Source: Own elaboration.

As the dependent variable is dichotomous, a Probit model is performed⁶. In addition, robust standard errors (Hubert-White) are calculated⁷. The results are presented in Table 4 two models are presented: the first one is a model without interactions between variables, and the second one includes the interactions, in order to test the joint effect of the age and the IT training of the micro entrepreneur.

The first model has no interactions, and in this model the predictions postulated by TAM and SBTC are tested: the development and improvement of techniques and skills related to the previous experience of the entrepreneur produce positively influences in the adoption of technologies. This result is in line with other authors as Franz and Robey (1986), Sorensen and Stuart (2000), Burke et al. (2002), Whesthead et al. (2005) and Papastathopoulos and Beneki (2010). These works demonstrate how firms with more experience tend to implement more efficient ICT strategies than younger, as does the education level and previous knowledge of those technologies (Bekman et al. 1998; Acemoglu 2002; Burke et al. 2002). According with the educational level, our results are in line with Holt y Crocker (2000), Batte (2005), Chibelushi and Costello (2009) and Lee Sang et al. (2010). Moreover, according with the study of the specific ICT training similar results can be found as Fulantelli and Allegra (2003), Barba Sánchez et al. (2007), and Admiraal and Lochhorst

⁶ The estimation has been performed using EViews v. 7. For models which may be estimated using second derivative methods, EViews uses quadratic hill-climbing as its default method. The effect of this modification is to push the parameter estimates in the direction of the gradient vector. The idea is that when we are far from the maximum, the local quadratic approximation to the function may be a poor guide to its overall shape, so may be better off simply following the gradient. The correction may provide better performance at locations far from the optimum, and allows for computation of the direction vector in cases where the Hessian is near singular.

⁷ The quasi-maximum likelihood (QML) estimators are robust in the sense that they produce consistent estimates of the parameters of a correctly specified conditional mean, even if the distribution is incorrectly specified, but the estimated standard errors computed using the inverse of the information matrix will not be consistent unless the conditional distribution of the dependent variable is correctly specified. However, it is possible to estimate the standard errors in a robust fashion so that a valid inference can be conducted, even if the distribution is incorrectly specified. EViews provides options to compute several types of robust standard errors, but the Huber/White option that computes QML standard errors has been chosen because in our case this option provides robust results.

(2009). These authors find a positive relationship between the training/educational level on ICT and its use.

However, age has a negative influence (probably because age is negatively correlated with the ease of use), as show several research (Warr 1993; Ford et al. 1996; Palvia and Palvia 1999; Chapman et al. 2000; Borghans and Weel 2002; Rouvinen 2002; Aubert et al. 2006; De Koning and Gelderblom 2006; Schleife 2006; Shih-Yung and Pearson 2011) due to the loss of cognitive technological skills and the increase of the resistance to change. Control variables are not relevant in the context of this analysis. The control variables are added in order to reduce the omitted variable bias, although in the context of this study the interpretation is not relevant. Anyway, the variable representing equity is positive and significant, which means that the higher the financial capacity, the higher is the behavioral intention to use new technologies. This result is in line with the research discussed above (Chacko and Harris 2005), which found a dependent relationship between the profitability and the use of ICT in small firms.

The second model contains the main hypotheses of this paper: when the interactions are included, what is analyzed is not the “isolated” influence of the variables of interest (namely AGE, ICT_KNOWLEDGE and EDUCATION) but the joint effects. The (AGExEDUCATION) interaction is not significant, which indicates that there are no joint effects between them, so hypothesis 1 is not supported. However, although this work and other studies discussed above, find a positive relationship between education and the use of ICT, it is not possible to conclude that this positive relationship moderate the negative relationship between age and the use of ICT.

Nevertheless, the interaction between AGE and ICT_KNOWLEDGE is positive and significant, which can be interpreted as follows: despite the fact that the first model proves that age influences negatively the adoption of new technologies, the truth is there is a joint effect, which implies that a greater previous knowledge of the technology neutralizes the negative effect of age. In other words, it is possible to increase the level of adoption of new technologies among older micro entrepreneurs by stimulating prior knowledge of those technologies. This result supports hypothesis 2. Summarizing, a higher level of IT training moderates the negative effect of age on the adoption of new technologies. This result is supported by Colin (2006), who explained that age is not an obstacle in the ICT adoption, due to the wealth of our framework in term of tools and systems.

In the second model, an interesting result is that the coefficients of the variables with no interaction (AGE, EDUCATION and ICT_KNOWLEDGE) became non significant. In other words, variables associated to the educational profile and the age of the entrepreneur loses their influence on ICT adoption in the firms in our sample, if those variables are not combined. This result is irrelevant, as what really matters are the interaction terms: according to the so-called “principle of marginality” (Nelder 1977), when the interaction terms are significant, the coefficients of the main variables named “main effects” must be neither tested nor interpreted (Fox 2008). Given that in our model there is a significant interaction term, (the variable representing the joint influence of age and the previous knowledge of ICT) the main effects associated to those variables do not reflect internal features of the data, so they can be ignored without loss of generality or interpretability of the model, and therefore only interaction terms must be interpreted.

The rest of the variables that have no interactions (EXPERIENCE, EQUITY and GEO_DISPERSION) do not substantially change their coefficients and remain significant, which can be interpreted as a sign of the robustness of the model. Also, the second model has better goodness-of-fit ratios: better R-squared, better log-likelihood and smaller AIC, which indicates that the interaction terms are relevant.

5. CONCLUDING REMARKS

This research focuses on studying the use and adoption of ICT in firms with less than ten employees in Spain. Previous theoretical results posit that internal factors are relevant in the adoption of ICT in the stratum of small and medium enterprises. This work agrees with this current of thought and is supported by the theoretical basis of the TAM and SBTC models, analyzing several internal variables in order to explain the adoption of ICT. Specifically, this work is concerned with testing how the education level of the micro entrepreneur and his previous knowledge of ICT neutralize the negative effect of the age of the micro entrepreneur on the use of ICT.

In this line, a field study has been performed with a survey of 148 microenterprises. Results show that previous knowledge of ICT moderates the negative effect of the age of the micro entrepreneur on the use and adoption of ICT, with a joint effect that implies that a higher previous knowledge neutralizes the negative effect of age. However, this joint effect is not supported in the case of the educational level.

Several conclusions, of a both theoretical and practical character, can be drawn from these results. From the theoretical point of view, this work is based on the TAM and SBTC models (Davis 1989), and is in the line of several recent works concerned with the study of the moderating effects and the interactions between variables (Venkatesh et al. 2003).

From the management point of view, the results suggest the need to encourage specific training in ICT in order to consolidate their use and adoption by the microenterprises. Training can help to generate greater levels of innovation in organizations, especially the SMEs, so that they get the most from their investment in training.

In this sense, specific training seems to promote a better use of the resources and increases the perceived utility of ICT, and thus the use of these technologies is encouraged. This kind of IT-specific training allows, not only for a better knowledge of these technologies, but also knowledge of other achievable, if more complex technologies, which are useful for the business, fostering the innovative capacity of the microenterprises.

Likewise, this kind of training allows for the updating of the knowledge and skills that are lost by the effect of age. This, in the long-run, leads to a more modern, innovative firm, making small size and competitiveness compatible. In the case of Spain, a higher competitiveness of very small enterprises is of great importance, and more in a context of crisis, due to their ability to increase the levels of employment and of economic development.

Promoting the competitiveness of the business framework, formed mostly by microenterprises, is vital to the survival of many economies which are today immersed in a serious economic crisis. The improvement of the microenterprises in many economies would result in a great contribution to national output and, above all, to job creation and economic development.

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