Digitalization and entrepreneur's gender: Evidence for Spanish SMEs in the service and retail sectors.

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Abstract

This study investigates the role of the entrepreneur's gender on digitalization strategies undertaken by SMEs in the service and retail sectors. Specifically, we aim at testing how the gender of the entrepreneur may affect investment in software and equipment related to information and communication technologies (ICT). We use a sample of 1,041 Spanish businesses and estimate a *bivariate probit* model for these two decisions, controlling for other entrepreneurial and business characteristics. Results indicate a higher probability of male entrepreneurs to invest in software and ICT equipment, as compared to women. Furthermore, we find that entrepreneurial risk-taking and business' innovation capabilities are important drivers for engaging in these two digitalisation strategies, regardless of the gender of the entrepreneur, and that entrepreneurial proactiveness is especially important for women entrepreneurs, since the positive impact of entrepreneurial proactiveness on the probability to engage in digitalisation strategies is stronger in women-led businesses. This study provides new empirical evidence on the role of entrepreneur's gender in SMEs regarding their digitalisation strategies.

Keywords: Gender of entrepreneur; small and medium-enterprises; digitalisation strategies; information and communication technologies; *bivariate probit* model.

JEL Classification: C35, J16, M21, L26.

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1. Introduction.

Business digitalization has become a critical and strategic topic in the EU context. The plan "Digital Compass 2030" aims at encouraging the digitalization transformation of EU businesses and societies through a wide implementation of Information and Communication Technologies (ICT) and other related technologies. All across Europe, and particularly in Spain, Next Generation EU funds are largely being devoted to the promotion of a digitalized economy. The 2021 Spanish Recovery and Resilience Plan pays special attention to supporting the adoption of ICT by SMEs. Specifically, EU targets to establish that at least 75% of companies should introduce new digital services and technologies by 2030 and at least 90% of EU firms should enhance their levels of digital intensity and skills.

It has been well documented in the literature that the adoption of ICT helps firms to gain competitive advantages and achieve better performance results (Añón Higon, 2011; Venkatesh et al., 2000). Recent studies, such as Barrientos-Marín et al. (2021), Okundaye et al. (2019), Tob-Ogu et al. (2018), and Tan et al. (2010) have discussed the advantages associated to the adoption of ICT in terms of business growth, competitiveness, efficiency of organizational processes, and reducing the earnings gap, among others. In the case of SMEs, the incorporation of new technologies, such as ICT, represents a fundamental resource for survival in a highly competitive market (Parker and Castelman, 2007). Moreover, these technologies play a decisive role in the digitalization and modernization of business practices, helping small firms to compete with bigger companies (Kusuma et al., 2020; Van Wart et al., 2017). In this regard, there is a wide variety of literature on the determinants and barriers that influence the adoption of these types of technologies by firms, as well as on the benefits and managerial strategies impacted by this technology adoption, both in developed countries (Meggiolaro, 2018; Ono and Zavodny, 2005) and developing ones (Tob-Ogu et al., 2018; Ndiege et al., 2014).

Though there is a wide consensus on the role played by owner-managers in the decision-making of SMEs, including ICT adoption (Gupta et al. 2009; Orser et al., 2019; Orser and Riding, 2018; Shepherd et al. 2015), results are still inconclusive regarding the influence of the manager's gender in these decisions. Most studies have found that male entrepreneurs are generally more likely to adopt ICT than female counterparts (Babic and Golob, 2018; MacGregor and Vrazalic, 2008; Oly Ndubisi and Cengiz, 2005). Conversely, other studies assert that adoption of technology by firms is gender neutral (Everett 2004; Rommes et al.,

2012). To the best of our knowledge, existing literature lacks of sufficient research analysing the potential role of the entrepreneur gender on ICT adoption in the case of SMEs. In this sense, we believe that this study is much needed since the gap in the adoption of ICT between male- and women-led businesses may lead to significant differences in the achievement of competitive advantages due to lower resource capabilities (Benitez-Amado et al., 2010). Additionally, in the last decades there has been a significant shift from traditional male-dominated sectors (e.g., agriculture, manufacturing and construction) towards a more service and retail-based activities where women have a substantial greater presence (MacGregor and Vrazalic, 2008). Therefore, these sectors should be individually analysed with the aim to avoid the male-biased sectors and adequately investigate gender differences in sectors with a higher presence of women, such as service and retail sectors. Further, as noted by MacGregor and Vrazalic (2008), not only women have increased their participation in the workforce worldwide, especially in these economic sectors, but technology has also played a significant role in facilitating gender equality, both in the general economy and in services specifically. In this sense, this study focuses on the service and retail sectors, where female entrepreneurs have a significant presence and technology adoption constitutes a decisive resource to enhance business survival and competitiveness.

Following the literature that considers gender as a decisive factor to explain entrepreneurial decisions, this study analyses the role of entrepreneur's gender on digitalization strategies in SMEs operating in the service and retail sectors. Additionally, we consider that gender may also affect other factors that might influence digitalisation decisions, such as the entrepreneur's proactiveness, his/her degree of risk tolerance, and the innovative capabilities of the firm. Therefore, our main research questions are the following. First, are SMEs run by men entrepreneurs more likely to engage in digitalisation strategies, in comparison to those run by women? Second, does the gender of the entrepreneur moderate the impact of entrepreneurial proactiveness and risk tolerance, and firm's innovation capabilities on digitalisation strategies?

To answer these research questions, we use a Spanish dataset obtained from a survey collected in 2012. The case of Spain is a suitable study context for various reasons. First, Spain still registers higher gender inequality levels in the economic and business fields, being far away from other EU countries, such as the Netherlands, Germany, Scandinavian countries and the UK (World Economic Forum, 2021). Second, gender and digitalization policies are nowadays attracting a lot of attention and public resources. In fact, the 2021 Spain Recovery

and Resilience Plan clearly sets gender-equality and digitalization goals in the business sector to be reached by 2030 at the latest. Our working sample consists of 1,041 SMEs of the service and retail sectors (68% of them corresponding to businesses run by men and 32% to businesses run by women). This survey contains relevant information about personal characteristics of the entrepreneur, such as gender, age and education, and also information regarding their proactiveness in running the business and disposition to assume risky projects. It also provides information at the business level, such as innovative capabilities, size, age and location. This information is very important for the analysis of gender disparities between male- and female-run businesses in digitalisation-related decisions. A *bivariate probit* model is used with the aim of estimating the joint probability of a firm to engage in two digitalisation strategies, investment in software and investment in physical ICT equipment, and also analysing the role played by the manager's gender and other entrepreneurial and firm characteristics on these decisions.

Our contribution to the existing literature is manifold. First, we add new empirical results to the scant literature comparing women- and men-run SMEs as regards their propensity to adopt ICT, and thus, to increase the knowledge on the role played by the entrepreneur's gender on the digitalisation of SMEs. Gender equality is a general goal in national and global agendas. However, due to cultural and institutional factors and the different male and female roles in society, a gender gap subsists in many areas, to women disadvantage, such as in entrepreneurship and technology adoption. This study might help to acknowledge the importance of women entrepreneurs in the digitalisation of the service and retail sectors, where women entrepreneurs register a higher representation than in other economic sectors, and may contribute to reduce gender gaps by providing useful information for policy-makers and entrepreneurs. Second, those studies on ICT adoption that have included gender issues have generally focused on the barriers for technology adoption (e.g, complexity and cost of the technology), so that the role played by gender on the decision to adopt different digitalisation strategies and its moderating role on other important traits of the entrepreneur and the firm have not been sufficiently analysed. Additionally, our work analyses two digitalisation strategies, that is, software and ICT equipment acquisition, taking into account that both decisions may be interrelated. In doing so, our study also adds to the literature examining complementarities between these two different technology tools as two distinctive types of digitalisation decisions by firms, and the suitability to jointly studying them. Third, this is the first study exploring the

links between entrepreneur gender, proactiveness, risk-taking and business' innovative capabilities, and digitalisation decisions.

The rest of this study is organized as follows. With the aim to define the research hypotheses to be tested, a brief literature review is offered in Section 2. The data and methodology used are presented in Section 3. Results are reported and discussed in Section 4, followed by a summary of main conclusions and practical implications in Section 5.

2. Literature review and hypotheses.

Existing literature shows that SMEs adoption of ICT is influenced by a variety of internal and external factors (Parker and Castleman, 2009), being the entrepreneur's gender one of them (Awa et al., 2011). Different theories, such as the Theory of Planned Behaviour (TPB) (Choudrie and Dwivedi, 2006; Harrison et al., 1997), the Technology Acceptance Model (TAM) (Riemenschneider et al, 2003), and the Resource-Based Theory (RBT) (Caldeira and ward, 2003), have been developed with the aim to investigate the decision process of ICT adoption (Chuang et al., 2009). Nevertheless, the impact of personal characteristics of the entrepreneur, such as gender, on the decision making of ICT adoption have not yet attracted sufficient attention in the literature (Alam et al., 2022). In this sense, the Upper Echelon Theory (UET) developed by Hambrick and Mason (1984) states the characteristics of the business decision-maker play a significant role in explaining business strategic decisions, such as ICT adoption, as well as the achievement of different performance outcomes (Chuang et al, 2007a; Dwivedi and Lal, 2007; Kusuma et al., 2020; Thong, 1999).

In recent years, the study of the influence of manager's gender on technology adoption has attracted more attention among policy makers and scholars (Awa et al., 2011; Chuang et al., 2009; Orser et al., 2019; Shepherd et al., 2015). Most studies have found that male entrepreneurs are generally more prone to adopt ICT than females (Babic and Golob, 2018; MacGregor and Vrazalic, 2008; Oly Ndubisi and Cengiz, 2005). Additionally, recent studies show that manager's gender may play a moderating role in the adoption of new technology through other differential factors influencing that decision (Güney-Frahm, 2018; Vekatesh and Morris, 2000; Vekatesh et al., 2000). Conversely, other studies stress that the adoption of technology by firms is gender neutral (Everett 2004; Dwivedi and Lal, 2007; Rommes et al., 2012). In this line, Goswami and Dutta (2016) argue that results remain unclear with respect to

the role played by gender in the propensity of the firm to adopt new technologies, thus depending on contextual factors, such as the business sector and the characteristics of the firm. In this regard, Orser and Riding (2018) argue that female managers are generally less aware of the ways in which ICT can promote business growth and internationalization. In the meta-analysis carried out by Legris et al. (2003), it is acknowledged that only the study of Venkatesh and Morris (2000) explicitly examines gender and managerial experience, finding that male males had better perceptions about the benefits of technology adoption than females. Nevertheless, none of the studies reviewed by Legris et al (2003) analysed ICT adoption in the context of SMEs (Orser and Riding, 2018). Consequently, more research on the role played by gender on ICT adoption by SMEs is needed.

Specifically, we consider that the gender of the entrepreneur may have a direct effect on ICT acquisition (software and equipment), but also and indirect effect through other factors, such as entrepreneur's proactiveness, his/her degree of risk tolerance and innovation capabilities of the firm, that might play a significant role on ICT decision-making. With this aim, the following hypothesis is to be tested.

Hypothesis 1: Male-run SMEs will register a higher probability of acquiring software and/or ITC equipment, as compared to female-run SMEs.

Gender and proactiveness of the entrepreneur

Proactivity constitutes an important dimension to characterize entrepreneurial orientation (Covin and Slevin, 1989). As defined by Lumpkin and Dess (1996), proactivity refers to the recognition of new business opportunities. Therefore, proactive entrepreneurs are characterized by the need to search for new markets (national and/or abroad) and to participate in activities that promote new business connections and opportunities to expand the business, such as trade fairs and industry exhibitions (Zahra et al., 1999; Zimmerman and Brouthers, 2012). With respect to role played by the entrepreneur's gender in proactiveness, some evidence on the differences between male- and female-led businesses has been reported. The work of Cliff (1998) showed that female-led SMEs were less oriented to achieve high growth rates, as well as to expand to international markets. DeTienne and Chandler (2007) found significant differences in the processes that explain the proactivity behaviour of male and female

entrepreneurs. Similarly, the works of Lim and Envick (2013) and Goktan and Gupta (2015) observed significant differences between male and female students in terms of their proactiveness towards entrepreneurship in favour to males. In this sense, the works of Gupta et al. (2009, 2014) argue that this lower interest showed by female entrepreneurs could be explained by the negative influence of gender stereotypes. Conversely, the study of Runyan et al. (2006) found no evidence of proactivity differences between male- and female-led SMEs. Therefore, we consider that the issue of how entrepreneur gender may influence the impact of proactiveness on the firm's adoption of ICT is still not sufficiently explored. To fill this gap, we aim to test if gender differences could imply that, even with similar proactiveness, female-run SMEs may be less likely to acquire ICT, as compared to those run by males. Thus, the following hypotheses need to be tested:

Hypotheses 2a: Proactiveness of the entrepreneur will have a positive impact on software acquisition and/or ICT equipment acquisition.

Hypotheses 2b: The positive impact of entrepreneur's proactiveness on software and ICT equipment acquisition is higher in male-run SMEs, as compared to those run by female.

Gender and risk tolerance of the entrepreneur

Technology-adoption decisions are usually determined by the entrepreneurial attitude towards risk. A variety of studies have analysed the relationship between the entrepreneur's gender and his/her level of risk aversion. Results show that, in general terms, male entrepreneurs tend to show higher levels risk tolerance than females. Studies, such as Sexton and Bowman-Upton (1990), Mínguez-Vera and Marin (2011), Weber and Geneste (2014), and Buratti et al. (2017), among others, have shown evidence on the higher propensity of male entrepreneurs to engage in risky projects, compared to females. Conversely, other studies have not found sufficient evidence on gender differences regarding the risk profile of the entrepreneur (Sonfield et al. 2001; Atkinson et al., 2003; Croson and Gneezy, 2009). Studies, such as Venkatesh and Morris (2000), Perez et al. (2002) and Kaygan et al. (2019), argue that women base their decision to adopt a new technology on their perception about the complexity and difficulty to use it. The study of Kaygan et al. (2019) considers that technology complexity is more congruent with the

masculine identity since complexity is associated to higher risk, and Perez et al. (2002) find that female managers of Spanish SMEs were more concerned with technical difficulties compared to men when adopting ICT.

Additionally, empirical evidence shows that the adoption of new technologies might imply important changes in their organizational processes, including knowledge and skills of the workforce, to guarantee a successful assimilation of the implemented technology (Rogers, 2003). In this sense, the adoption of ICT can be clearly affected by the risk profile of the entrepreneur. Therefore, we consider that risk-tolerance of the entrepreneur may have a greater impact on ICT adoption in male-run SMEs. Consequently, following research hypotheses are presented:

Hypotheses 3a: Risk-tolerance of the entrepreneur will have a positive impact on software acquisition and/or ICT equipment acquisition.

Hypotheses 3b: The positive impact of risk-tolerance on software and ICT equipment acquisition is higher in male-run SMEs, as compared to those run by females.

Gender and innovative capabilities

The study of the relationship between entrepreneur's gender and innovation capabilities of the firm has attracted an increasing attention among scholars in recent years. A recent literature review on this issue can be found in the work of Arun and Rojers (2021). Studies such as Alsos et al. (2013), Marvel et al. (2015), and Reutzel et al. (2018), among others, have pointed out significant differences between male and female entrepreneurs in undertaking innovation decisions. In this same line, Weber and Geneste (2014) and Buratti et al., (2017) have documented that female entrepreneurs were less interested in innovation implementation in their firms, thus investing fewer resources in R&D activities within the firm due to the associated risks and the significant financial and human resources needed for a successful technological implementation, such as hiring specialized ICT consulting companies and investment in R&D activities. Despite the increasing literature on this subject, other studies have found inconclusive results in the role played by gender in determining the innovation

capabilities of the firm (Alsos et al., 2013; Buratti et al., 2017; Elam et al., 2019; Expósito et al., 2021; Link, 2017). Additionally, few studies analyse a multi-sector sample of firms, mainly focusing on traditional industrial and technological sectors. Therefore, non-technological sectors, such as services and other female-oriented sectors, have generally been understudied (Alsos et al., 2013; Nählinder et al., 2012; Pettersson and Lindberg, 2013). This research aims to fill this gap by focusing on the analysis of the role played by entrepreneur's gender on the innovative capabilities of firms in the service and retail sectors to implement ICT. Therefore, the following hypotheses are to be tested:

Hypotheses 4a: Innovation capabilities of the firm will have a positive impact on software acquisition and/or ICT equipment acquisition.

Hypotheses 4b: The positive impact of innovative capabilities on software and ICT equipment acquisition is higher in male-run SMEs, as compared to those run by females.

3. Data and methodology.

3.1. Sample and data

The data we use has been drawn from a survey on business competitiveness for Spanish small and medium-sized enterprises (SMEs) carried out in 2012.[1] From this survey we select those businesses operating in the services and retail sector. In addition, since our focus is on the comparison between women- and men-led established SMEs, we include in our sample only those SMEs that have been operating in the market for at least three years. The rationale for this selection is to focus on SMEs that have overcome the difficulties associated with the setup

[1] The survey was carried out by a professional consultancy company and financed by a competitive national research project. The surveyed population were businesses with less than 250 employees, excluding self-employed entrepreneurs without employees, and sales volume below 50 million euros, and located in six Spanish regions, representing the southern, central and northern regions of Spain, and corresponding to a 41% of Spanish SMEs in 2012. The population was stratified by size and sector, according to the criteria of the Central Directory of Firms (Spanish National Institute of Statistics). The response rate achieved was 20.8% and no bias was observed between respondents and non-respondents.

stage, which have been found to be harder in the case of women (Aristei and Gallo 2016; Koellinger et al., 2013). Under these criteria our sample then corresponds to 1,041 SMEs, of which 365 businesses operate in the retail sector, and 678 in the services sector. Out of these, 328 are women-led SMEs (31.51%), whereas 713 are men-led SMEs (68.49%). Thus, our final sample is composed of a ratio of 2.17 men entrepreneur for every women entrepreneur running an SME. This ratio is in accordance to the average figure reported by official statistics (Spanish Ministry of Industry, Energy and Tourism, 2013) and similar to the ratio of other studies.[2]

The survey provides information regarding personal attributes of the main decision-maker of the business, or entrepreneur, including gender, age, education level, and self-reported personality traits, such as proactiveness and attitude towards risks, and also information related to the business characteristics, such as engagement in innovation activities, number of employees, business age and sector, among others.[3] The information also includes two digitalization strategies, such as the acquisition of software and the acquisition of equipment (including computer equipment) by the business during the three years previous to the survey (period 2009-2011).[4]

In order to test for the different hypotheses stated in the previous section, we use the information provided by the questionnaire to build a number of variables, as follows.

3.2. Dependent variables

According to Calvino et al. (2018, p.8), "digitalization is a complex phenomenon that is hardly captured by a single indicator". In this work we use two technological components of digitalization proposed by Calvino et al. (2018): investment in software and investment in ICT equipment (investment in computer hardware and telecommunication equipment). These two dimensions are likely to be positively correlated with the digitalization transformation of the firm in a broader sense (Calvino et al., 2018). Further, digital technologies affect different sectors in heterogeneous ways, depending on the dimension of digitalization considered, so that

[2] For instance, in the work of Koellinger et al. (2013) the ratio of male to female entrepreneurs is 2.15.

[3] The survey does not provide information regarding the gender of owners nor the gender composition of the board of directors. Therefore, it is not possible to analyze gender diversity among owners or within the board of directors.

[4] See Table A1 in Appendix for a description of all variables used in our analysis.

the two indicators we analyze are usually higher for services sectors as compared to manufacturing. Hence, we use two dependent variables capturing these two digitalization strategies, *Software acquisition* and *Equipment acquisition*, corresponding to two dummy variables indicating whether the business has acquired software and equipment (including computer equipment) during the previous three years, respectively.

3.3. Independent variables

To test the hypotheses stated in Section 2, we build a number of relevant variables using the information provided by the survey. Regarding entrepreneur's gender, we construct a binary variable that takes value one if the entrepreneur (or major decision-maker of the business) is a man, and value of zero if it is a woman. Regarding entrepreneurs' proactiveness, we use two indicators. First, the entrepreneur is asked to state whether she/he regularly searches for new markets and new economic opportunities. From this information we build a binary variable indicating than the entrepreneur is *Searching for new opportunities.* Second, the entrepreneur reports whether she/he participates in trade fairs and business conferences and exhibitions on a regular basis. From this information we create the binary variable *Participation in trade fairs*. As regards risk tolerance, entrepreneurs are asked to report their willingness to undertake projects of high risk and high expected returns, from which we construct the variable *High risk-takin*g, that takes value one when the entrepreneur reports a high willingness to take risks. Finally, regarding firms' innovation capabilities, we consider two variables. The first one is a variable indicating engagement in R&D expenditures during the last three years (*R&D engagement*). The second is a variable indicating the use of services from consulting companies to innovate (*Use of consulting services*).

3.4. Control variables

Following the literature, we also control for other entrepreneurial and business characteristics that may be considered as drivers of SMEs digitalization strategies. First, in relation to other personal attributes of the entrepreneur, the questionnaire asks about the level of education attained by the entrepreneur, since higher levels of education may be related to higher propensities to introduce digitalization strategies in SMEs. In this respect, our analysis includes two binary variables to indicate that the entrepreneur has attained tertiary (university) education

or secondary education, respectively. Additionally, we also consider the age of the entrepreneur, since younger entrepreneurs may be more prone to pursue digitalization strategies, as compared to older ones.

Second, regarding business characteristics we include the age of the business, measured as the number of years elapsed since its constitution (with a minimum of three years). We also control for the size of the firm by including the number of employees. This is important when analysing gender differences in strategies since female entrepreneurs show a preference for businesses of a smaller size. Further, the questionnaire contains information regarding the obstacles that entrepreneurs find in running their businesses. In particular, we use two indicators on whether the business report *Difficulty in finding finance* and *Difficulty in finding qualified personnel*. We consider that these obstacles in running the business may also have an impact on the decision to adopt digitalization strategies. In addition, to capture the influence of external or environmental factors, we include sectoral and regional dummy variables. Regarding the industry sector, we include two binary variables accounting for retail, and services, respectively. As for regional dummies, they correspond to the six Spanish regions included in our analysis. We rely on these sectoral and regional dummies to capture differences in the levels of technology among sectors, and also differences in the availability of resources, such as infrastructures, and policy and regulations among regions.

3.5 Methodology

To test our hypotheses, we jointly consider the two digitalization strategies: acquisition of software and acquisition of ICT equipment, since they might be related. To estimate these two decisions, we use a bivariate *probit* model that allows them to be correlated. Thus, we estimate a *bivariate* discrete choice model, as follows:

$$\begin{aligned} Software\ adquisition_i &= \begin{cases} 1 & if\ \ \beta_0^{soft} + \beta_1^{soft} X_{1i}^{soft} + \beta_2^{soft} X_{2i}^{soft} + \varepsilon_i^{soft} \\ 0 & otherwise \end{cases} \\ Equipment\ adquisition_i &= \begin{cases} 1 & if\ \ \beta_0^{equip} + \beta_1^{equip} X_{1i}^{equip} + \beta_2^{equip} X_{2i}^{equip} + \varepsilon_i^{equip} \\ 0 & otherwise \end{cases} \end{aligned} \quad (1)$$

where the subscript *i* is and indicator of the SME. We use two dichotomous variables as dependent variables. Each of these variables takes value one when the entrepreneur states to

have acquired software and equipment, respectively, in the previous three years, and zero otherwise. X_{1i} is a vector of variables accounting for personal traits of the entrepreneur (gender, proactiveness, tolerance to risky projects, education and age). X_{2i} is a vector of firms' characteristics that may influence the decision to acquire software and/or equipment, such as engagement in R&D activities, participation in trade fairs, size, age, industry and region. Finally, ε_i is an error term.

The bivariate specification we use will permit systematic correlations among the two choices.[5] The rationale for this is that there might be complementarities or substitutabilities between the two types of digitalization strategies. Should we find that there exists a significant correlation between the two strategies, then estimating two separate *probit* models for each of the two choices would be inefficient. The estimation of our models is undertaken through the simulated maximum-likelihood two-equation *probit* model using the Geweke-Hajivassiliou-Keane (GHK) smooth recursive simulator to compute the maximum likelihood.

4. Results

4.1. Descriptive statistics

We present some descriptive statistics of the sample of SMEs we analyse, including the mean and standard deviation of all variables, separately for those SMEs run by a man (68.49%) and those run by a woman (31.51%). We observe that, on average, SMEs run by men entrepreneurs report both software and equipment acquisition to a greater extent than SMEs run by females: 60% of men-led businesses have acquired new software, whereas this figure is only 54% in the case of women-led businesses. Regarding equipment, 86.9% of men-led businesses have acquired new equipment, whereas in the case of women-led firms this figure is 82.3%. In both cases, the differences in means by entrepreneur's gender are statistically significant. Hence, on average, these two digitalisation strategies are pursued by men-led SMEs to a greater extent than women-led SMEs. Regarding entrepreneurial traits, searching for new opportunities is reported similarly by both men and women entrepreneurs, but participation in business trade

[5] Notice that the models don't require the two decisions being indeed related, but rather allow for all possible combinations, in the sense that businesses may differ in the type of acquisition they make.

fairs, conferences and exhibitions is higher for men entrepreneurs, in comparison to women, (74.3% and 68.5%, respectively), being this difference statistically significant. It also emerges that risk-tolerance is higher for women entrepreneurs in our sample (27%), as compared to male entrepreneurs (23%), and the difference is statistically significant. Regarding education, both tertiary and secondary education is higher for women entrepreneurs, although the difference with respect to men is only statistically significant in the case of tertiary education. Finally, male entrepreneurs are older on average (48 years) than female ones (44 years) and this difference is statistically significant.

Regarding business characteristics, Table 1 also reports that the proportion of businesses that engage in R&D activities is similar in men- and women-led SMEs, 31% and 32%, respectively. Regarding the proportion of SMEs that use of consulting services for their innovation activities, the proportion is similar in men-led and women-led businesses, 34.0% and 36.8%, respectively. We also observe that SMEs run by men provide regular training to their employees in similar proportions to SMEs run by women (74,1% and 72.5%, respectively). Regarding the obstacles in running the businesses, we observe that 51.4% of men-led SMEs claim to experience difficulties in obtaining finance for its normal activities, whereas this figure is 42% for women-led SMEs, being this difference statistically significant; in addition, 43.7% of men-led businesses claim to experience difficulties in finding qualified personnel, whereas this is only the case for 39.9% of women-led SMEs, although the difference in this case is not statistically significant. Two further business characteristics that differ greatly by gender are the size of the workforce and the business's age. Men-led SMEs have on average 8 employees and are 18 years old, whereas women-led SMEs have 5 employees and are 14 years old, being these gender differences statistically significant. Finally, regarding the sectors under analysis, around 35% of men and women entrepreneurs operate in the retail sectors, whereas the proportion of SMEs in the services sector is around 65%, both for men-led and women-led businesses.

[Insert Table 1 about here]

Table 2 provides information on the digitalization strategies followed by the firms in our sample. It includes the number of SMEs that have acquired software and equipment, distinguishing between retail and services, the two sectors under analysis. We observe that these

two digitalization strategies are adopted to a greater extent by SMEs in the services sectors, as compared to the retail one, and that equipment acquisition is greater than software acquisition in both sectors. On the whole, we observe that these two digitalization strategies are adopted by the firms in our sample to an important degree.

[Insert Table 2 about here]

Finally, Table 3 presents the Pearson correlation matrix for all the variables included in this study. The Variance Inflation Factors (VIFs) for explanatory variables are reported in the final row of the table. All VIFs are smaller (or equal) to 2.82, indicating that the results are free from multicollinearity concerns (Chatterjee et al., 2000).

[Insert Table 3 about here]

4.2. Regression results

Tables 4 and 5 present the estimation results of the *bivariate probit* model regarding the SME's probability to acquire software and to acquire equipment, as specified in expression (1) above. We observe that the correlation between these two decisions (coefficients ρ) is positive and statistically significant in all specifications, confirming that both decisions are positively related, and the convenience of jointly estimating them.

[Insert Table 4 around here]

The first specification of Table 4 only contains the entrepreneur's gender (a dichotomous variable that takes value one when the entrepreneur is a man, and value zero when the entrepreneur is a woman). In specification 2 we add all other explanatory variables. We observe that in these two specifications the gender of the entrepreneur has a significant and positive impact on the probability of acquiring software and equipment, even when we control for a number of entrepreneurial and firm characteristics. Hence, our Hypothesis 1 is validated for both digitalisation strategies.

Regarding entrepreneurial proactiveness, we find that our first indicator, searching for new opportunities has no effect on either software or equipment acquisition, but we find that participating in business trade fairs has a positive and significant impact on both decisions. This result provides support to Hypothesis 2a. As regard risk-tolerance of the entrepreneur, we obtain that it has a positive and significant impact on the probability to acquire software, but no effect on the acquisition of equipment, so that Hypothesis 3a is only partially supported. Further, our results indicate that innovative capabilities increase the probabilities of both software and equipment acquisition. Engagement in R&D activities has a significant and positive effect on software acquisition, whereas the use of consulting companies for innovation has a significant and positive impact on both digitalization strategies. Hence, Hypothesis 4a is supported by our findings.

Regarding control variables, we obtain that entrepreneur's education is important for software acquisition but not for equipment acquisition. The age of the entrepreneur affects positively to the acquisition of software, but negatively to the acquisition of equipment, so that older entrepreneurs are more prone to acquire software and less prone to acquire equipment. Regarding business characteristics, regular employees' training has a significant and positive effect on software acquisition but no impact on equipment acquisition. Our findings also reveal that the size of the SME, measured as the number of employees, and the age of the business do not significantly affect digitalization strategies. Business difficulty in finding qualified personnel has a positive impact on the probability of equipment acquisition, pointing out to a substitution effect between human capital and physical capital. Finally, those businesses in the services sectors show a higher probability to acquire equipment, as compared to businesses in the retail sector.

Table 5 reports the *bivariate probit* estimates of the decisions to acquire software and equipment including in a parsimonious way the interaction of the entrepreneur's gender with those entrepreneurial and business characteristics affecting digitalisation strategies that are assumed to differ by gender. Hence, we interact entrepreneur's gender with the variables indicating searching for new opportunities, participation in trade fairs, high risk-tolerance, R&D engagement and use of consulting companies, respectively.

[Insert Table 5 around here]

Specifications (1) and (2) in Table 5 show the results for the interaction of gender with our two indicators of entrepreneur's proactiveness. We observe in specification (1) that there is no role for gender on the impact of *Searching for new opportunities* on the probability of software acquisition. However, both gender and its interaction with *Searching for new opportunities* are significant on the probability of equipment acquisition. In particular, we obtain that male entrepreneurs are more likely to acquire equipment, but among those entrepreneurs searching for new opportunities, male entrepreneurs are less prone to acquire equipment, as compared to women entrepreneurs. Regarding specification (2), we observe a significant impact of both gender and its interaction with *Participation in trade fairs* on the probability of both software and equipment acquisition. The coefficient of gender is positive and significant, indicating that men entrepreneurs are more likely to acquire both software and equipment, but the interaction term is significant and negative, indicating that male entrepreneurs participating in trade fairs are less prone to both types of digitalisation strategies, as compared to women entrepreneurs. Hence, the results of specifications (1) and (2) are contrary to Hypothesis 2b. As regards to entrepreneurial risk-tolerance, specification (3) shows that neither gender nor its interaction with *High risk-tolerance* have any impact on either software or equipment acquisition. Hence entrepreneur' gender has no role on the impact of risk tolerance on the two digitalization decisions. Hypothesis 3b is then not supported by our results. Finally, specifications (4) and (5) report the results of the interaction of entrepreneur's gender with the two indicators of innovative capabilities, *R&D engagement* and *Use of consulting companies* for innovation, respectively. Specification (4) shows that the coefficient of gender is only significant in the probability of equipment acquisition, so that men entrepreneurs are more likely to acquire equipment, in comparison to women. Regarding specification (5), we observe that there is no role for entrepreneur' gender on how the use of consulting companies affect both digitalization strategies. In addition, in specifications (4) and (5) none of the coefficients corresponding to the interacted terms of entrepreneur's gender with the variables capturing innovative capabilities are statistically significant. Hence, we obtain that gender has no influence on the impact of innovative capabilities as drivers of the two digitalisation decisions, and hence Hypothesis 4b is not supported by our results. As regards to the estimated coefficients for the control variables, the results we obtain are similar to those reported in Table 4.

4.3. Discussion of results

Our findings reveal that men-led SMEs show a higher propensity to acquire software and ICT equipment, as compared to women-led SMEs, even when we control for other entrepreneurial personal traits and businesses characteristics. This is the main contribution of our study since the role of entrepreneur's gender on digitalization strategies has not been sufficiently explored in the literature so far. Our results are in line with those of Babic and Golob (2018), Güney-Frahm (2018), MacGregor and Vrazalic (2008), Oly Ndubisi and Cengiz (2005), and Vekatesh and Morris (2000), among others, who found that male entrepreneurs are generally more likely to adopt ICT, as compared to female counterparts.

Our results also indicate that entrepreneur's proactiveness, risk-tolerance, and business innovative capabilities are important drivers for adopting digitalisation strategies, such as software and equipment acquisition. In addition, we obtain that there is a role for gender regarding entrepreneur proactiveness, since our findings show that the gender of the entrepreneur moderates the two ICT acquisition decisions. In particular, women entrepreneurs with a proactive attitude are more likely to acquire software and equipment for their businesses, as compared to men. This is a novel contribution to the literature that underlines the importance of proactiveness, in particular for female entrepreneurs, when deciding to undertake software and equipment acquisitions. Our findings also suggest that risk-tolerance and business innovative capabilities are gender neutral, that is, they are equally relevant for men- and women-led SMEs for the two digitalisation decisions, and they are not influenced by the gender of the entrepreneur, confirming the results of Dwivedi and Lal (2007) and Rommes et al. (2012), among others.

Our findings also raise the question of why do women entrepreneurs are less prone to acquire both software and equipment as compared to men. Some plausible and tentative explanations for these results may be mentioned. First, women entrepreneurs are likely to face gender-specific obstacles to get involved in digitalisation strategies, such as access to financial resources, information and networks. These obstacles are usually faced by small businesses led by women and are higher for women entrepreneurs than for men (Brush et al., 2002). These

obstacles may determine that the intention of ICT adoption is greater for men, compared to women entrepreneurs, as pointed out by Orser and Riding (2018).

Second, there is a gender education bias so that men tend to focus on technical fields of study that provide them the know-how and skills they need to easily undertake digitalization strategies (Walters and McNeely, 2010). By contrast, women tend to choose non-technical areas of study so that they are at disadvantage as regards to digitalization decisions, in comparison to men (Link, 2017; Link and Link, 1999). These educational and training disparities between men and women entrepreneurs could lead to different perceptions about the usefulness and complexities of ICT adoption, thus affecting their decisions in different ways for men and women (Legris et al., 2003; Meggiolaro, 2018; Ono and Zavodny, 2005).

Third, the lower propensity of women entrepreneurs to undertake digitalisation strategies could also be related to perceptions of potential negative gender stereotypes. The studies of Gupta et al. (2009) and Goktan and Gupta (2015) have revealed that gender stereotypes may affect negatively to women' willingness to undertake decisions usually categorized as masculine. As a consequence, women entrepreneurs may be less prone towards ICT adoption, which they may consider technically complex decisions more appropriate for men entrepreneurs.

Unfortunately, we cannot control for these factors with our data, and therefore, investigating the reasons explaining these findings is beyond the scope of our work. Nonetheless, we consider that our findings contribute to a better understanding regarding the influence of the entrepreneur's gender on the digitalisation strategies of SMEs, and they provide insights that may help designing policy tools to boost ICT adoption among SMEs. Digitalisation policies should include gender initiatives to promote digitalization in retail and services, as well as programmes to reduce gender segregation in education and in the labour market.

5. Concluding remarks

This empirical study has investigated the influence of the entrepreneur's gender on SMEs digitalisation strategies in the service and retail sectors. Our results indicate a higher probability of men entrepreneurs to invest in software and ICT equipment, in comparison to women entrepreneurs, after controlling for a number of entrepreneurial and firm characteristics. This

finding is the main contribution of our study since the issue of entrepreneurs' gender and software and ICT equipment acquisition has not been explored in the literature so far. Our findings also suggest that women entrepreneurs could be facing gender-related obstacles to digitalise their businesses, and in particular, to invest in software and ICT equipment. In addition, it also raises the question of why are women-led SMEs less prone to undertake ICT investments, and how public policy might promote digitalisation strategies of women entrepreneurs as a means for enhancing their competitiveness in the market.

In addition, we find that entrepreneurial risk-taking and business' innovation capabilities are key determinants for engaging in digitalisation strategies, irrespective of the entrepreneur's gender. These findings suggest that risk tolerance and innovation capabilities are equally important for men- and women-led businesses for the two digitalisation decisions. Regarding proactiveness, our results indicate that this entrepreneurial trait is especially important for women, since the positive impact of entrepreneurial proactiveness on the probability to engage in digitalisation strategies is stronger in women-led SMEs. Thus, it is critical for women entrepreneurs interested in digitalisation to hold a proactive attitude regarding the search of new economic opportunities and new markets, and to participate regularly in business trade fairs, conferences and exhibitions.

Our work contributes to the acknowledgement of the influence of entrepreneur's gender on digitalisation strategies of SMEs and provide important insights for entrepreneurs and policymakers regarding the promotion of digitalisation strategies by firms. Our work suggests the need to incorporate a gender perspective in those policies dealing with boosting the process of SMEs digitalisation, and in particular the need to foster the digitalization of women businesses. If women-led SMEs lag behind men-led SMEs in terms of digitalization, their businesses performance will be negatively affected, and so their competitive advantage in the market, in comparison to business run by men. In addition, our findings indicate that to enhance digitalisation of women-led SMEs policymakers should focus on encouraging their proactivity attitudes, such as searching for new economic opportunities and new markets, and participating in business trade fairs and exhibitions.

Finally, we should recognise a number of limitations of our work. First, our analysis is based on a representative sample of Spanish businesses in the service and retail sectors, and

while our results are likely to arise in other SMEs sectors, they should be validated for other countries. Second, since we analyse cross-sectional data, caution should be taken regarding causal links when interpreting our results. Third, we have investigated the role of entrepreneur's gender on two indicators of digitalisation, namely, investment in software and ICT equipment, and have not analysed the influence of gender on other digitalisation strategies, which opens a path for further research. Lastly, our sample needs to be updated with the aim to investigate if our results (based on information obtained in 2012) are valid to describe the current behaviour of SMEs in a post-Covid context.

References

Alam, K., Ali, M. A., Erdiaw-Kwasie, M. O., Murray, P. A., Wiesner, R. (2022). Digital transformation among SMEs: Does gender matter? *Sustainability*, 14, 535.

Alsos, G.A., Hytti, U., Ljunggren, E. (2013). Gender and innovation: state of the art and a research agenda. *International Journal of Gender and Entrepreneurship*, 5(3), 236-256.

Añón Higon, D. (2011). The impact of ICT on innovation activities: Evidence for UK SMEs. *International Small Business Journal*, 30(6), 684-699.

Arun, T. M., Rojers, J.P. (2021). Gender and firm innovation - A systematic literature review and future research agenda. *International Journal of Entrepreneurial Behavior & Research*, 27 (2), 301-333.

Atkinson, S. M., Baird, S. B., Frye, M. B. (2003). Do female mutual fund managers manage differently? *Journal of Financial Research*, 26(1), 1-18.

Awa, H. O., Eze, S. C., Urieto, J. E., Inyang, B. (2011). Upper echelon theory (UET). A major determinant of information technology (IT) adoption by SMEs in Nigeria. *Journal of Systems and Information Technology*, 13(2), 144-162

Babic, S., Golob, M. (2018). Investigating attitudes of entrepreneurs towards the use of information and communication technologies in Croatian SMEs in two Northern Adriatic counties. 41st International Convention on Information and Communication Technology, Electronics and Microelectronics, Croatia.

Barrientos-Marín, J., N. Fu, Millán, J. M., van Stel, A. (2021). ICT usage at work as a way to reduce the gender earnings gap among European entrepreneurs. In Technology and Women's Empowerment, Lechman, E. (Ed.), chapter 6, 101–118, Routledge.

Benitez-Amado, J., Llorens-Montes, F. J., Perez-Arostegui, M. N. (2010). Information technology- enabled intrapreneurship culture and firm performance. *Industrial Management and Data Systems*, 110(4), 550-566.

Brush, C. G., Carter, N. M., Greene, P. G., Hart, M. M., & Gatewood, E. (2002). The role of social capital and gender in linking financial suppliers and entrepreneurial firms: A framework for future research. *Venture Capital: An international journal of entrepreneurial finance*, *4*(4), 305-323.

Buratti, A., Cesaroni, F. M. Se, ntitu, A. (2017). Does gender matter in strategies adopted to face the economic crisis? A comparison between men and women entrepreneurs. In *Entrepreneurship-Development Tendencies and Empirical Approach*.

Calvino, F., Criscuolo, C., Marcolin, L., Squicciarini, M. (2018). A taxonomy of digital intensive sectors. OECD Science, Technology and Industry Working Papers, 2018/14, OECD Publishing, Paris.

Choudrie, J., Dwivedi, Y. K. (2006). Investigating factors influencing adoption of broadband in the household. *Journal of Computer Information Systems*, 46(4), 25-34.

Chuang, T., Nakatani, K., Zhou, D. (2009). An exploratory study of the extent of information technology adoption in SMEs: an application of upper echelon theory. *Journal of Enterprise Information Management*, 22(1/2), 183-96.

Chuang, T., Rutherford, M., Lin, B. (2007). Owner/manager characteristics, organizational characteristics and IT adoption in the SMEs. *Journal of Management and Enterprise Development*, 4(6), 619-34.

Cliff, J. (1998). Does one size fit all? Exploiting the relationship between attitudes towards growth, gender and business size. *Journal of Business Venturing*, 13, 523-442.

Covin, J. G., Slevin, D. P. (1989). Strategic management of small firms in hostile and benign environments. *Strategic Management Journal*, 10(1), 75-87.

Croson, R., Gneezy, U. (2009). Gender differences in preferences. *Journal of Economic Literature*, 47(2).

DeTienne, D. R., Chandler, G. N. (2007). The role of gender in opportunity identification. *Entrepreneurship Theory and Practice*, 31(3), 365-386.

Dwivedi, Y., Lal, B. (2007). Socio-economic determinants of broadband adoption. *Industrial Management & Data Systems*, 107(5), 654-71.

Elam, A. B., Brush, C. G., Greene, P. G., Baumer, B., Dean, M., Heavlow, R. (2019). *Global Entrepreneurship Monitor: Women's Entrepreneurship* 2018/2019 Report. Wellesley, M.A.

Everett, A. (2014). On cyberfeminism and cyberwomanism: high-tech mediations of feminism's discontents. *Signs*, 30(1), 1278–1286.

Expósito A., Sanchis-Llopis, A., Sanchis-Llopis, J. A. (2021). CEO gender and SMEs innovativeness: evidence for Spanish businesses. *International Entrepreneurship and Management Journal*. https://doi.org/10.1007/s11365-021-00758-2

Goktan, A. B., Gupta, V. K. (2015). Sex, gender, and individual entrepreneurial orientation: evidence from four countries. *International Entrepreneurship and Management Journal*, 11(1), 95-112.

Goswami, A., Dutta, S. (2016) Gender Differences in Technology Usage—A Literature Review. *Open Journal of Business and Management*, 4, 51-59.

Güney-Frahm, I. (2018). A new era for women? Some reflections on blind spots of ICT-based development projects for women's entrepreneurship and empowerment. *Gender, Technology and Development*, *22*(2), 130-144.

Gupta, V. K., Goktan, A. B., Gunay, G. (2014). Gender differences in evaluation of new business opportunity: a stereotype perspective. *Journal of Business Venturing*, 29(2), 273-288.

Gupta, V.K., Turban, D.B., Wasti, S.A. and Sikdar, A. (2009). The role of gender stereotypes in perceptions of entrepreneurs and intentions to become an entrepreneur. *Entrepreneurship: Theory and Practice*, 33(2), 397-417.

Hambrick, D., Mason, P. (1984). Upper Echelons: the organization as a reflection of its top managers. *Academy of Management Review*, 9(2), 193–205.

Harrison, D. A., Mykytyn, P. P., Riemenschneider, C. K. (1997). Executive decisions about adoption of information technology in small business: Theory and empirical tests. *Information Systems Research*, 8, 171–195.

Kaygan, H., Kaygan, P., Demir, O. (2019). A pen that 'looks like a CEO in a business suit': gendering the fountain pen. *Journal of Gender Studies*, 28(1), 86-96,

Kusuma, H., Muafi, M., Mustiko, H., Pamungjas, S. (2020). Information and communication technology adoption in Small-and-medium-sized enterprises: Demographic characteristics. *Journal of Asian Finance, Economics and Business*, 7(10), 969–980

Legris, P., Ingham, J., Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management*, 40(3), 191–204.

Lim, S., Envick, B. R. (2013). Gender and entrepreneurial orientation: a multi-country study. *International Entrepreneurship and Management Journal*, 9(3), 465-482.

Link, A. N. (Ed.). (2017). *Gender and entrepreneurial activity*. Edward Elgar Publishing.

Link, A. N., Link, J. R. (1999). Women in science: An exploratory analysis of trends in the United States. *Science and Public Policy*, 26(6), 437-442.

Lumpkin, G. T., Dess, G. G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of Management Review*, 21(1), 135-172.

Macgregor, R. C., Vrazalic, L. (2008). The role of gender in the perception of barriers to E-commerce adoption in SMEs: an Australian study. *Communications of the IBIMA*, 4. 141-147.

Marvel, M. R., Lee, I. H. I., Wolfe, M. T. (2015). Entrepreneur gender and firm innovation activity: a multilevel perspective. *IEEE Transactions on Engineering Management*, 62(4), 558-567.

Meggiolaro, S. (2018). Information and communication technologies use, gender and mathematics achievement: evidence from Italy. *Social Psychology of Education*, *21*(2), 497-516.

Mínguez-Vera, A., Martin, A. (2011). Gender and management on Spanish SMEs: an empirical analysis. *The International Journal of Human Resource Management*, 22(14), 2852-2873.

Nählinder, J., Tillmar, M., Wigren-Kristoferson, C. (2012). Are female and male entrepreneurs equally innovative? Reducing the gender bias of operationalisations and industries studied, in Andersson, S., Berglund, K., Torslund, J.G., Gunnarsson, E. and Sundin, E. (Eds.), *Promoting Innovation – Policies, Practices and Procedures*, VINNOVA, Stockholm.

Ndiege, J., Herselman, M., Flowerday, S. (2014). Absorptive Capacity and Information Technology Adoption Strategies: A Study of SMEs in Kenya. *The African Journal of Information Systems Volume*, *6*(4), 140-155.

Okundaye, K., Fan, S. K., Dwyer, R. J. (2019). Impact of information and communication technology in Nigerian small-to medium-sized enterprises. *Journal of Economics, Finance and Administrative Science*, *24*(47), 29-46.

Oly Ndubisi, N., Cengiz, K. (2005). Malaysian women entrepreneurs: Understanding the ICT usage behaviors and drivers. *Journal of Enterprise Information Management*, 18(6), 721-739.

Ono, H., Zavodny, M. (2005). Gender Differences in Information Technology Usage: a U.S-Japan comparison. *Sociological Perspectives*, *48*(1), 105-133.

Orser, B., Riding, A., Li, Y. (2019). Technology adoption and gender-inclusive entrepreneurship education and training. *International Journal of Gender and Entrepreneurship*, 11(3), 273-298

Orser, B.J., Riding, A. (2018). The Influence of Gender on the Adoption of Technology Among SMEs. *International Journal of Entrepreneurship and Small Business. 33* (4), 514–531.

Parker, C., Castleman, T. (2007). New directions for research on SME-eBusiness: Insights from an analysis of journal articles from 2003 to 2006. *Journal of Information Systems and Small Business,* 1(1), 21–40.

Parker, C., Castleman, T. (2009). Small firm e-business adoption: a critical analysis of theory*, Journal of Enterprise Information Management*, 22(1/2), 167-182,

Perez, M. P., Carnicer, M. P., Sanchez, A. M. (2002). Differential Effects of Gender Perceptions of Teleworking by Human Resources Managers. *Women in Management Review*, 17(6), 262-275.

Pettersson, K., Lindberg, M. (2013). Paradoxical spaces of feminist resistance: Mapping the margin to the masculinist innovation discourse. *International Journal of Gender and Entrepreneurship*, 5(3), 323-341.

Reutzel, C. R., Collins, J. D., Belsito, C. A. (2018). Leader gender and firm investment in innovation. *Gender in Management: An International Journal*, 33(6), 430-450.

Riemenschneider, C. K., Harrison, D. A., Mykytyn, P. P. (2003). Understanding it adoption decisions in small business: integrating current theories. *Information & Management*, 40(4), 269-285.

Rogers, E. M., (2003). Diffusion of Innovations, Free Press, New York.

Rommes, E., Bath, C., Maass, S. (2012). Methods for intervention: gender analysis and feminist design of ICT. *Science, Technology, & Human Values*, 37(6), 653–662.

Runyan, R. C., Huddleston, P., Swinney, J. (2006). Entrepreneurial orientation and social capital as small firm strategies: A study of gender differences from a resource-based view. *The International Entrepreneurship and Management Journal*, 2, 455.

Sexton, D. L., Bowman-Upton, N. (1990). Female and male entrepreneurs: Psychological characteristics and their role in gender-related discrimination. *Journal of Business Venturing*, 5(1), 29-36.

Shepherd, D. A., Williams, T. A., Patzelt, H. (2015). Thinking about entrepreneurial decision making: review and research agenda. *Journal of Management*, 41(1), 11-46.

Sonfield, M., Lussier, R., Corman, J., McKinney, M. (2001). Gender comparisons in strategic decision-making: an empirical analysis of the entrepreneurial strategy matrix. *Journal of Small Business Management*, 39(2), 165-173.

Tan, K. S., Chong, S. C., Lin, B., Eze, U. C. (2010). Internet- based ICT adoption among SMEs: Demographic versus benefits, barriers, and adoption intention. *Journal of Enterprise Information Management*, *23*(1), 27-55.

Thong, J. (1999). An integrated model of information systems adoption in small businesses. *Journal of Management Information Systems*, 15(4), 27-31.

Tob-Ogu, A., Kumar, N., Cullen, J. (2018). ICT adoption in road freight transport in Nigeria – A case study of the petroleum downstream sector. *Technological Forecasting and Social Change*, *131*(November 2016), 240-252.

Venkatesh, V., Morris, M.G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS Quarterly*, 24(1), 115-139.

Venkatesh, V., Morris, M. G., Ackerman, P. L. (2000). A longitudinal field investigation of gender differences in individual technology adoption decision-making processes. *Organizational Behavior and Human Decision Processes*, 83(1), 33-60.

Walters, J., McNeely, C.L. (2010). Recasting Title IX: Addressing gender equity in the science, technology, engineering, and mathematics professoriate. *Review of Policy Research*, 27(3), 317-332.

Weber, C., Geneste, L. (2014). Exploring gender-related perceptions of SME success. *International Journal of Gender and Entrepreneurship*, 6, 15-27.

World Economic Forum (2021). Global Gender Gap Report 2021. Insight Report. World Economic Forum, Geneve.

Zahra, S. A., Jennings, D. F., Kuratko, D. F. (1999). The antecedents and consequences of firm-level entrepreneurship: The state of the field. *Entrepreneurship Theory and Practice*, 24(2), 45-65.

Zimmerman, M. A., Brouthers, K. D. (2012). Gender heterogeneity, entrepreneurial orientation and international diversification. *International Journal of Gender and Entrepreneurship*, 4(1), 20-43

Table A1. Definition of variables.

Variable name	Definition
Entrepreneur's gender	Dummy variable taking the value of 1 if the manager of the business is male, and the value of 0 if female.
Software acquisition	Dummy variable taking the value of 1 if the business has acquired software during the last three years, and 0 otherwise.
Equipment acquisition	Dummy variable taking the value of 1 if the business has acquired equipment (including hardware) during the last three years, and 0 otherwise.
Searching for new opportunities	Dummy variable taking the value of 1 if the entrepreneur reports searching regularly for new markets and new economic opportunities, and zero otherwise.
Participation in trade fairs	Dummy variable taking the value of 1 if the business attends regularly business trade fairs, conferences and exhibitions, and 0 otherwise.
High risk-tolerance	Dummy taking the value of 1 if the entrepreneur reports having a high predisposition to undertake projects of high risk and high expected returns.
R&D engagement	Dummy variable taking the value of 1 if the business performs R&D activities, and 0 otherwise.
Use of consulting services	Dummy variable taking the value of 1 if the business makes use of the services of consulting companies to innovate, and 0 otherwise.
Tertiary education	Dummy variable taking the value of 1 if the entrepreneur holds a university degree, and 0 otherwise.
Secondary education	Dummy variable taking the value of 1 if the entrepreneur holds secondary education, and 0 otherwise.
Age of the entrepreneur	Log of the age of the entrepreneur.
Employee's training	Dummy variable taking the value of 1 if the employees receive training regularly, and 0 otherwise.
Age of business	Log of the age of the business, measured as the number of years since its founding.
Log (number of employees)	Log of the average number of employees in the business, not considering the entrepreneur.
Difficulty in finding finance	Dummy variable taking the value of 1 if the business claims to experience difficulties in obtaining finance for its normal activities, and 0 otherwise
Difficulty in finding qualified personnel	Dummy variable taking the value of 1 if the business claims to experience difficulties in finding qualified personnel, and 0 otherwise
Services	Dummy variable taking the values of 1 if the business belongs to the Services sector, and 0 otherwise.
Retail	Dummy variable taking the values of 1 if the business belongs to the retail sector, and 0 otherwise.
Region	Six dummy variables corresponding to six Spanish regions (Autonomous Communities): 1. Andalusia; 2. Extremadura; 3. Madrid; 4. Murcia; 5. Navarra; 6. Basque Country.

Table 1. Mean and standard deviation of variables by entrepreneur gender.

	Male entrepreneur		Female entrepreneur		
	Mean	**s.d.**	**Mean**	**s.d.**	**Difference**
Digitalization strategies					
Software acquisition	0.605	0.489	0.545	0.498	0.060*
Equipment acquisition	0.869	0.337	0.823	0.382	0.046*
Entrepreneurial traits					
Searching for new opportunities	0.666	0.472	0.670	0.467	-0.013
Participation in trade fairs	0.743	0.437	0.685	0.464	0.057*
High risk-tolerance	0.230	0.421	0.277	0.448	-0.047*
Tertiary education	0.496	0.500	0.554	0.497	-0.058*
Secondary education	0.350	0.480	0.371	0.484	-0.012
Age of the entrepreneur	48.129	9.977	44.576	8.629	3.552***
Business characteristics					
R&D engagement	0.318	0.466	0.323	0.468	0.004
Use of consulting services	0.340	0.474	0.368	0.483	-0.028
Employees training	0.741	0.437	0.725	0.446	0.016
Difficulty in finding finance	0.514	0.500	0.420	0.494	0.093***
Difficulty in finding qualified employees	0.437	0.496	0.399	0.490	0.038
Number of employees	8.184	16.269	5.604	10.149	2.580***
Age of Business	18.095	14.199	14.530	10.149	3.564***
Business sector					
Retail	0.352	0.477	0.341	0.474	0.010
Services	0.647	0.477	0.658	0.474	-0.010
Number of observations	713		328		

Note: ***, ** and * indicate that the difference between male and female entrepreneur mean is significant at the 1%, 5% and 10% levels, respectively.

Table 2. Software and equipment acquirers by sectors.

	Total businesses		Software		Equipment	
	Number of businesses	(%)	Number of businesses	(% within sector)	Number businesses	(% within sector)
Sector						
Retail	363	34.87	192	52.89	299	82.36
Services	678	64.13	419	61.80	591	87.16
Total businesses	1,041	100	611		890	

Note: The percentages in the columns of software and equipment acquirers are calculated over the number of businesses within each sector.

Table 3. Correlations of main independent variables.

Panel A: Analysis of pairwise correlation coefficients

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Entrepreneur's gender	1														
2. Searching for new opport.	-0.012	1													
3. Particip. in trade fairs	0.062**	0.157***	1												
4. High risk-tolerance	-0.05	0.053*	0.046	1											
5. R&D engagement	-0.004	0.140***	0.132***	0.093***	1										
6. Use consulting companies	-0.026	0.099***	0.019	0.037	0.094***	1									
7. Tertiary education	-0.056*	0.103***	0.038	-0.024	0.121***	0.062**	1								
8. Secondary education	-0.011	0.012	-0.017	0.021	-0.098***	0.004	-0.778***	1							
9. Age of entrepreneur	0.164***	-0.085**	0.040	-0.022	0.005	0.005	-0.091***	-0.019	1						
10. Employees training	0.016	0.123***	0.130***	0.051	0.096***	0.168***	0.101***	-0.039	-0.028	1					
11. Log(number employees)	0.130***	0.132***	0.079**	0.016	0.114***	0.182***	0.087***	-0.054*	0.099***	0.274***	1				
12. Age of business	0.128***	-0.065**	0.080**	-0.061**	0.008	0.053*	-0.082***	0.001	0.315***	0.084***	0.258***	1			
13. Dif. finding finance	0.100***	0.059*	-0.011	0.122***	0.068*	0.002	-0.028	0.013	0.003	0.039	-0.003	-0.032	1		
14. Dif. finding qual. empl.	0.035	0.033	0.099***	0.056*	0.076*	-0.023	-0.022	0.019	-0.066**	0.054*	-0.002	-0.021	0.085***	1	
15. Services	-0.011	0.001	-0.144***	0.004	0.112***	0.012	0.170***	-0.106***	-0.066**	0.149***	0.027	-0.195***	-0.057*	0.013	1

Panel B: Multicollinearity diagnostics using Variance Inflation Factor (VIF)

	1.07	1.11	1.11	1.04	1.09	1.07	2.82	2.68	1.16	1.17	1.22	1.26	1.05	1.03	1.15

Notes:

1. Pearson's correlation matrix.
2. Variance Inflation Factor (VIF).
3. *** Significant at 1%, ** at 5% and * at 10%.

Table 4. Bivariate *probit* estimates of software and equipment acquisitions.

	(1)		(2)	
Dependent variables	Software	Equipment	Software	Equipment
Entrepreneur's gender	0.155*	0.185*	0.163*	0.181*
	(0.084)	(0.100)	(0.091)	(0.108)
Searching for new opportunities			0.103	-0.146
			(0.090)	(0.110)
Participation in trade fairs			0.203**	0.200*
			(0.095)	(0.112)
High risk-tolerance			0.184*	-0.050
			(0.098)	(0.116)
R&D engagement			0.286***	0.054
			(0.092)	(0.112)
Use of consulting companies			0.218**	0.265**
			(0.089)	(0.113)
Other entrepreneurs' traits				
Tertiary education			0.885***	-0.050
			(0.140)	(0.169)
Secondary education			0.548***	-0.271
			(0.140)	(0.168)
Age of entrepreneur			0.477**	-0.458*
			(0.213)	(0.250)
Other business characteristics				
Employees training			0.251**	0.156
			(0.099)	(0.116)
Log (number of employees)			0.032	0.044
			(0.066)	(0.071)
Age of the business			0.068	0.095
			(0.069)	(0.083)
Difficulty in finding finance			0.076	0.036
			(0.087)	(0.105)
Difficulty in finding qualified employees			0.091	0.204*
			(0.091)	(0.113)
Services			0.163	0.209*
			(0.091)	(0.108)
Constant	0.113	0.935***	-3.419***	1.961**
	(0.069)	(0.081)	(0.831)	(0.958)
N. Observations	1,041		1,041	
$\rho_{software\_equipment}$	0.543***		0.609***	
	(0.048)		(0.073)	
LR test of ρ=0:				
Chi²(1)	90.532		69.635	
Prob > Chi²	(0.000)		(0.000)	

Notes:

1. Entrepreneur's gender is a binary variable taking value of one if the entrepreneur is a man, and cero if she is a woman.
2. ***, **, * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
3. Standard errors given in parentheses. Sectoral and regional dummies included in all specifications.

Table 5. Bivariate *probit* estimates of software and equipment acquisitions. Gender interactions with searching for new opportunities, participation in trade fairs, high risk-tolerance, R&D engagement and use of consulting companies, respectively.

	(1)		(2)		(3)		(4)		(5)	
Dependent variables	**Software**	**Equipment**	**Software**	**Equipment**	**Software**	**Equipment**	**Software**	**Equipment**	**Software**	**Equipment**
Entrepreneur's gender	0.123	0.446**	0.458***	0.680***	0.117	0.095	0.097	0.250**	0.122	0.121
	(0.155)	(0.181)	(0.165)	(0.183)	(0.104)	(0.125)	(0.108)	(0.127)	(0.111)	(0.128)
Gender#Searching new opp.	0.057	-0.398*	-	-	-	-	-	-	-	-
	(0.187)	(0.221)								
Gender#Part. in trade fairs	-	-	-0.425**	-0.763***	-	-	-	-	-	-
			(0.196)	(0.226)						
Gender#High risk-tolerance	-	-	-	-	0.186	0.324	-	-	-	-
					(0.202)	(0.234)				
Gender#R&D engagement	-	-	-	-	-	-	0.215	-0.240	-	-
							(0.191)	(0.231)		
Gender#Use consulting c.	-	-	-	-	-	-	-	-	0.120	0.195
									(0.185)	(0.224)
Searching for new opport.	0.064	0.107	0.117	-0.126	0.102	-0.149	0.100	-0.145	0.101	-0.148
	(0.156)	(0.178)	(0.091)	(0.111)	(0.091)	(0.110)	(0.091)	(0.110)	(0.091)	(0.110)
Participation in trade fairs	0.202**	0.206*	0.482***	0.671***	0.203**	0.204*	0.203**	0.196*	0.202**	0.195*
	(0.096)	(0.112)	(0.160)	(0.178)	(0.095)	(0.112)	(0.095)	(0.112)	(0.095)	(0.112)
High risk-tolerance	0.185*	-0.047	0.185*	-0.059	0.065	-0.249	0.186*	-0.049	0.185*	-0.048
	(0.098)	(0.116)	(0.098)	(0.117)	(0.163)	(0.183)	(0.0980)	(0.116)	(0.0980)	(0.116)
R&D engagement	0.284***	0.059	0.286***	0.045	0.286***	0.051	0.142	0.209	0.284***	0.050
	(0.092)	(0.112)	(0.092)	(0.113)	(0.092)	(0.112)	(0.157)	(0.189)	(0.092)	(0.112)
Use of consulting companies	0.217**	0.272**	0.228**	0.295***	0.218**	0.267**	0.216**	0.271**	0.138	0.143
	(0.089)	(0.113)	(0.090)	(0.114)	(0.089)	(0.113)	(0.089)	(0.113)	(0.152)	(0.179)
Other entrepreneurs' traits										
Tertiary education	0.883***	-0.038	0.870***	-0.068	0.882***	-0.043	0.884***	-0.034	0.884***	-0.039

	(0.140)	(0.170)	(0.140)	(0.171)	(0.140)	(0.169)	(0.140)	(0.170)	(0.140)	(0.170)
Secondary education	0.547***	-0.274	0.535***	-0.303*	0.546***	-0.275	0.543***	-0.270	0.547***	-0.273
	(0.140)	(0.169)	(0.141)	(0.170)	(0.140)	(0.169)	(0.140)	(0.169)	(0.140)	(0.169)
Age of entrepreneur	0.477**	-0.438*	0.474**	-0.460*	0.473**	-0.463*	0.488**	-0.475*	0.477**	-0.461*
	(0.213)	(0.250)	(0.213)	(0.252)	(0.213)	(0.250)	(0.213)	(0.250)	(0.213)	(0.250)
Other business characteristics										
Employees training	0.251**	0.148	0.245**	0.145	0.253**	0.158	0.248**	0.160	0.249**	0.153
	(0.099)	(0.116)	(0.099)	(0.116)	(0.099)	(0.116)	(0.099)	(0.116)	(0.099)	(0.116)
Log (number of employees)	0.033	0.050	0.037	0.053	0.033	0.046	0.030	0.049	0.033	0.046
	(0.057)	(0.072)	(0.057)	(0.072)	(0.057)	(0.071)	(0.057)	(0.072)	(0.057)	(0.071)
Age of the business	0.066	0.093	0.073	0.110	0.065	0.093	0.068	0.096	0.065	0.093
	(0.068)	(0.083)	(0.069)	(0.083)	(0.068)	(0.083)	(0.068)	(0.083)	(0.068)	(0.083)
Difficulty in finding finance	0.076	0.042	0.078	0.046	0.076	0.036	0.072	0.041	0.077	0.037
	(0.087)	(0.105)	(0.088)	(0.106)	(0.088)	(0.105)	(0.088)	(0.105)	(0.088)	(0.105)
Dif. in finding qualified employees	0.092	0.208*	0.089	0.206*	0.093	0.206*	0.091	0.206*	0.088	0.199*
	(0.091)	(0.114)	(0.091)	(0.114)	(0.091)	(0.113)	(0.0901	(0.113)	(0.091)	(0.113)
Services	0.164*	0.208*	0.171*	0.225**	0.163*	0.207*	0.165*	0.208*	0.165*	0.212*
	(0.091)	(0.109)	(0.091)	(0.109)	(0.091)	(0.109)	(0.091)	(0.108)	(0.091)	(0.108)
Constant	-3.387***	1.723*	-3.609***	1.652*	-3.368***	2.043**	-3.405***	1.973**	-3.380***	2.028**
	(0.838)	(0.968)	(0.837)	(0.970)	(0.833)	(0.961)	(0.831)	(0.958)	(0.833)	(0.962)
Observations	1,041		1,041		1,041		1,041		1,041	
$\rho_{software\_equipment}$	0.613***		0.596***		0.608***		0.618***		0.608***	
	(0.073)		(0.073)		(0.073)		(0.074)		(0.073)	
LR test of ρ=0: $Chi^2(1)$	70.021		66.176		69.308		70.382		69.386	
Prob > Chi^2	0.000		0.000		0.000		0.000		0.000	

Notes:

1. Entrepreneur's gender is a binary variable taking value of one if the entrepreneur is a man, and cero if she is a woman.
2. ***, **, * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
3. Standard errors given in parentheses. Sectoral and regional dummies included in all specifications.

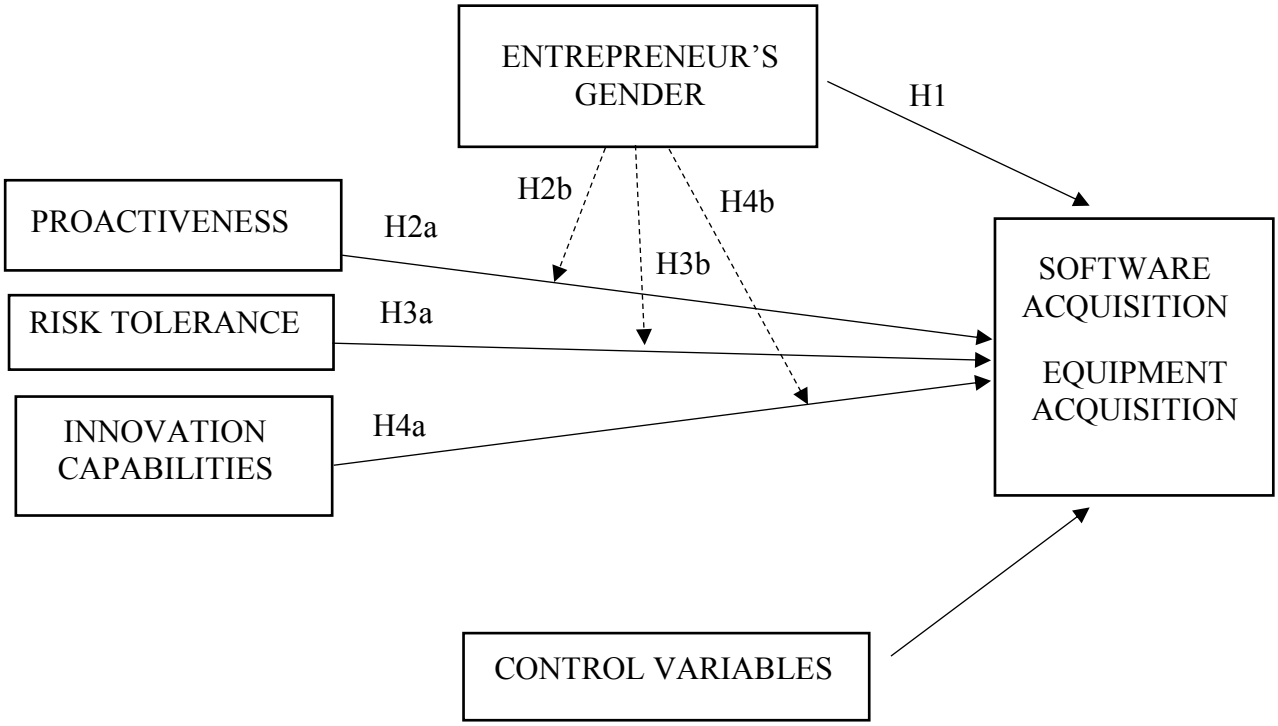

Figure 1. Conceptual framework and hypotheses